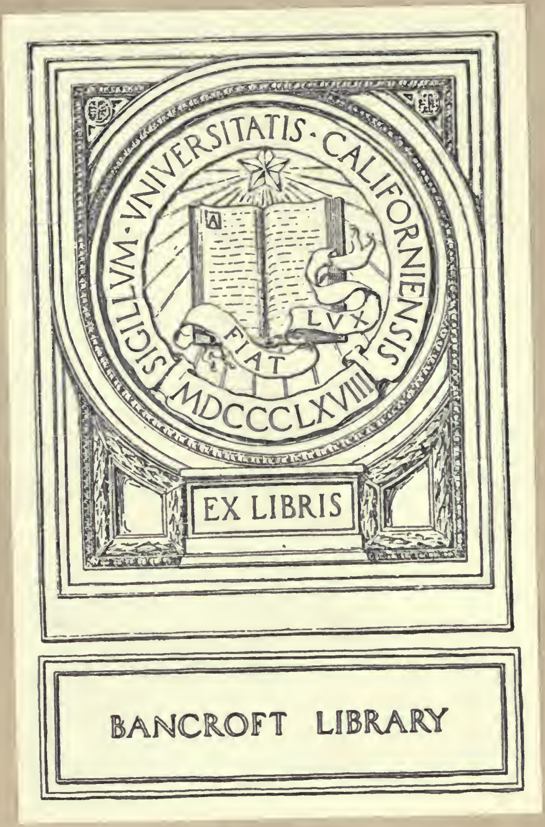
No. 58

HYDROGRAPHIC OFFICE
U.S. NAVY

THE NAVIGATION
OF THE
PACIFIC OCEAN, CHINA SEAS
AND
CONNECTING WATERS



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Errata, H. O. No. 58, The Navigation of the Pacific Ocean, etc.

Page 40, line 18, read Howe for Horn.
66, line 11, read section 105 for section 104.
93, line 15, last half, lines 16 and 17, erase.
112, line 7, read 10° N. for 10° S.
112, line 5 from bottom, read 10° N. for 10° S.
121, line 10 from bottom, read section 171 for section 166.
123, line 26, read section 133 for section 132.
128, line 25, read section 133 for section 132.
130, line 4 from bottom, read section 130 for section 129.
136, foot-note, read 39° S. for 3° S.
147, line 19, read 35° for 45°.
147, line 19, read "in latter case" for "even then."
160, line 22, read 180° for 170°.
162, line 4, read section 173 for section 152.
166, line 4 from bottom, read section 101 for section 102.
168, line 8 from bottom, read Blanco for Blaco.
170, line 7, read section 126 for section 12.
170, line 5 from bottom, read section 108 for section 109.
173, line 13, read section 140 for section 139.
174, line 6, read Ireland for Iceland.
176, line 13, read section 108 for section 107.
176, line 19, read section 141 for section 140.
177, line 23, erase section 111.
180, line 18, read section 105 for section 104.
201, line 1, read section 158 for section 157.
201, line 20, read section 155 for section 154.
218, foot-note, erase "3d."
228, line 20, read section 116 for section 115.
239, line 5, read Australia for Austria.

No. 58. George Davidson

UNITED STATES HYDROGRAPHIC OFFICE.
BUREAU OF NAVIGATION, NAVY DEPARTMENT.

ack by G.D.

Maya June/94

THE NAVIGATION
OF THE
PACIFIC OCEAN, CHINA SEAS
AND
CONNECTING WATERS.

TRANSLATED AT THE UNITED STATES HYDROGRAPHIC OFFICE
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MONS. F. LABROSSE.

WASHINGTON:
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1893.

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1893

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PREFACE.

The Navigation of the Pacific ocean, originally translated at this office by J. W. Miller, Lieutenant, U. S. Navy, contains much valuable information about the winds, currents, and routes of this ocean. The edition of 1875 having become exhausted it is republished with changes and additions.

RICHARDSON CLOVER,
Lieut.-Com'd'r U. S. Navy,
Hydrographer.

U. S. HYDROGRAPHIC OFFICE,
Washington, D. C., January, 1893.

ELLINOR C. DAVIDSON ESTATE
DECEMBER 1945

NOTE.

The bearings and courses are true. The direction of the winds, the points from which they blow; of currents, the points to which they set. Distances are expressed in nautical miles.

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CALMS, WINDS, CIRCULAR STORMS, BAROMETER, CURRENTS, ICE.

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PART I.

METEOROLOGY.

CALMS, WINDS, STORMS, BAROMETER, CURRENTS, STREAMS, ICE.

CHAPTER I.

CALMS—WINDS—CIRCULAR STORMS—BAROMETER.

§ 1. **Calm-belts, Equatorial and Tropical Calms.**—The following tables give for every five degrees square the percentage of calms to be expected. Blank squares indicate that sufficient data have not been received to make a tabulation of any value.

Table showing the chances of calms.

LATITUDES.	LONGITUDES EAST.																LONGITUDES WEST.																					
	From 100° to 105°.	From 105° to 110°.	From 110° to 115°.	From 115° to 120°.	From 120° to 125°.	From 125° to 130°.	From 130° to 135°.	From 135° to 140°.	From 140° to 145°.	From 145° to 150°.	From 150° to 155°.	From 155° to 160°.	From 160° to 165°.	From 165° to 170°.	From 170° to 175°.	From 175° to 180°.	From 180° to 175°.	From 175° to 170°.	From 170° to 165°.	From 165° to 160°.	From 160° to 155°.	From 155° to 150°.	From 150° to 145°.	From 145° to 140°.	From 140° to 135°.	From 135° to 130°.	From 130° to 125°.	From 125° to 120°.	From 120° to 115°.	From 115° to 110°.	From 110° to 105°.	From 105° to 100°.	From 100° to 95°.	From 95° to 90°.	From 90° to 85°.	From 85° to 80°.	From 80° to 75°.	From 75° to 70°.
JANUARY, FEBRUARY, MARCH.																																						
From 55° to 60° north																																						
50° to 55° north																					0																	
45° to 50° north							4	4									2	2	2	0	1	1	0	1	0	1	4											
40° to 45° north		C	H	I	N	A	4	4	4	4	1	1	1	1	1	2	3	2	2	2	2	2	1	2	1	1	1				A	M	E	R	I	C	A	
35° to 40° north							7	7	10	10	1	1	1	1	1	1	2	2	2	2	0	0	5	5	2	2	1	1										
30° to 35° north					0	3	7	7	3	3	2	1	1	1	1	2	4	6	4	2	0	0	5	5	2	2	1	1	12									
25° to 30° north					3	3	2	2	5	5	2	1	1	1	1	1	2	1	9	1	3	3	1	1	2	2	1	1	2	2								
20° to 25° north			0	0	3	3	2	2	5	5	3	2	1	1	1	1	2	2	2	9	3	3	1	2	2	2	1	1	2	4	12							
15° to 20° north		0	1	1	0	0	1	1	1	1	2	2	1	1	2	2	2	9	2	1	3	4	0	0	0	0	1	1	1	1	2	15	8	8				
10° to 15° north	0	0	1	1	0	0	1	1	1	1	1	1	1	1	2	2	2	8	2	1	3	3	0	0	0	0	1	1	1	1	1	13	8	8	0			
5° to 10° north		0	0	---	1	1	1	1	1	1	1	1	1	2	2	3	5	5	5	3	2	2	0	0	3	3	4	4	4	3	8	7	3	3	5	5	5	
0° to 5° north	1	2	---	---	1	1	1	1	1	1	1	2	2	2	4	5	5	5	5	3	6	2	0	0	3	3	4	6	3	2	5	1	3	3	5	5	3	
0° to 5° south															4	10	3	6	1	2	1	0	1	0	1	2	3	5	0	1	1	0	3	0	5	4		
5° to 10° south															1	14	13	6	6	6	5	0	6	2	1	0	0	2	0	0	0	0	0	0	1	3		
10° to 15° south															0	1	2	6	14	0	4	4	4	4	3	1	6	0	0	0	0	0	0	0	0	1	5	
15° to 20° south			A	U	S	T	R	A	L	I	A				0	0	10	2	8	6	1	7	10	8	8	7	12	2	0	0	0	0	0	0	2	0	0	10
20° to 25° south														0	3	1	4	1	5	3	2	5	6	9	20	5	5	7	0	5	0	0	0	0	3	5	4	10
25° to 30° south												0	2	0	0	4	1	2	6	6	5	4	15	11	10	4	8	3	0	4	2	0	11	0	9	7	3	2
30° to 35° south											2	3	10	3	3	2	1	6	12	5	2	1	2	6	12	0	6	10	6	10	12	9	5	6	5	5	4	8
35° to 40° south							6	7	2	4	2	4	2	2	4	6	2	10	9	2	1	6	6	4	6	1	3	2	0	6	3	4	4	7	4	5	3	7
40° to 45° south							2	2	5	5	1	0	0	0	3	2	7	2	1	0	0	1	0	6	6	5	0	0	6	2	0	0	0	2	8	5	3	4
45° to 50° south							1	0	1	2	1	0	1	2	3	2	0	2	2	1	0	3	1	0	2	1	1	4	2	2	4	2	0	1	3	4	2	

Table showing the chances of calms—Continued.

LATITUDES.	LONGITUDES EAST.																LONGITUDES WEST.																					
	From 100° to 105°.	From 105° to 110°.	From 110° to 115°.	From 115° to 120°.	From 120° to 125°.	From 125° to 130°.	From 130° to 135°.	From 135° to 140°.	From 140° to 145°.	From 145° to 150°.	From 150° to 155°.	From 155° to 160°.	From 160° to 165°.	From 165° to 170°.	From 170° to 175°.	From 175° to 180°.	From 180° to 175°.	From 175° to 170°.	From 170° to 165°.	From 165° to 160°.	From 160° to 155°.	From 155° to 150°.	From 150° to 145°.	From 145° to 140°.	From 140° to 135°.	From 135° to 130°.	From 130° to 125°.	From 125° to 120°.	From 120° to 115°.	From 115° to 110°.	From 110° to 105°.	From 105° to 100°.	From 100° to 95°.	From 95° to 90°.	From 90° to 85°.	From 85° to 80°.	From 80° to 75°.	From 75° to 70°.
APRIL, MAY, JUNE.																																						
From 55° to 60° north										0	---	---	---	---	---	---	---	---	---	---	---	---	5	5	5													
50° to 55° north										0	---	---	---	---	---	---	4	4	2	3	2	2	5	5	1	1												
45° to 50° north								2	5	5	2	1	2	2	2	2	2	2	2	3	2	2	2	2	2	2	1											
40° to 45° north	C	H	I	N	A		12	12	5	5	1	1	1	1	1	2	2	4	3	2	2	2	2	2	2	2	1			A	M	E	R	I	C	A		
35° to 40° north						9	8	8	1	1	1	1	1	1	1	3	7	2	5	5	3	3	3	3	4	4	2											
30° to 35° north						4	8	8	1	1	2	1	1	1	1	2	3	3	4	5	3	3	3	3	4	4	2	2										
25° to 30° north					0	0	3	3	6	6	3	2	1	1	1	2	3	3	9	4	1	1	2	2	3	3	0	0	3	3								
20° to 25° north			1	0	0	0	3	3	6	6	2	2	1	1	1	1	2	2	4	0	1	1	2	2	3	3	0	0	3	3	2							
15° to 20° north		0	2	2	2	2	3	3	3	3	2	1	1	1	1	1	2	2	2	0	2	2	0	0	0	0	0	0	6	6	80	80						
10° to 15° north		2	2	2	2	2	3	3	3	3	1	1	1	1	1	1	2	2	2	0	2	2	0	0	0	0	0	0	6	6	80	80	15					
5° to 10° north	3	3	3	3	1	1	0	1	0	1	1	2	2	2	3	3	5	5	7	4	2	2	2	2	2	2	3	3	4	4	2	2	4	4	2	2	7	
0° to 5° north	5	5	3	3	1	1	1	1	1	1	1	1	2	3	5	5	7	2	2	0	2	2	2	2	2	2	3	3	4	4	2	2	4	4	2	2	2	
0° to 5° south													0	4	17	1	2	0	0	5	2	3	0	0	0	0	0	3	3	2	0	0	0	0	1	1		
5° to 10° south															0	0	0	4	3	12	4	4	0	0	3	0	0	2	0	0	0	0	0	0	0	1		
10° to 15° south													0	---	0	0	0	6	4	0	9	10	2	4	0	0	4	1	0	0	0	0	0	3	1	2	3	
15° to 20° south		A	U	S	T	R	A	L	I	A	0	0	0	---	0	4	5	3	5	10	0	5	6	6	0	3	3	0	15	0	0	0	0	0	4	2	1	9
20° to 25° south											0	5	6	0	7	1	6	5	9	5	2	3	3	2	0	0	1	6	0	0	0	0	2	7	6	0	2	6
25° to 30° south											0	3	2	7	2	1	1	1	3	3	8	10	2	0	0	0	6	6	0	0	9	0	0	0	5	15	2	3
30° to 35° south											0	8	0	0	3	3	2	5	2	5	3	0	0	0	0	12	0	0	0	14	1	12	0	4	4	3	5	7
35° to 40° south							2	4	3	1	3	7	2	0	4	13	3	0	0	0	0	4	0	0	0	0	0	0	0	0	15	3	2	4	0	5	3	7
40° to 45° south							1	0	1	0	0	2	0	0	9	4	10	0	4	6	2	0	0	5	6	0	4	0	0	2	0	7	0	4	3	3	2	
45° to 50° south							0	0	2	0	0	12	1	0	8	1	0	0	0	0	1	0	6	9	6	4	0	0	1	0	0	3	0	0	1	3	4	

Table showing the chances of calms—Continued.

LATITUDES.	LONGITUDES EAST.																LONGITUDES WEST.																					
	From 100° to 105°.	From 105° to 110°.	From 110° to 115°.	From 115° to 120°.	From 120° to 125°.	From 125° to 130°.	From 130° to 135°.	From 135° to 140°.	From 140° to 145°.	From 145° to 150°.	From 150° to 155°.	From 155° to 160°.	From 160° to 165°.	From 165° to 170°.	From 170° to 175°.	From 175° to 180°.	From 180° to 175°.	From 175° to 170°.	From 170° to 165°.	From 165° to 160°.	From 160° to 155°.	From 155° to 150°.	From 150° to 145°.	From 145° to 140°.	From 140° to 135°.	From 135° to 130°.	From 130° to 125°.	From 125° to 120°.	From 120° to 115°.	From 115° to 110°.	From 110° to 105°.	From 105° to 100°.	From 100° to 95°.	From 95° to 90°.	From 90° to 85°.	From 85° to 80°.	From 80° to 75°.	From 75° to 70°.
JULY, AUGUST, SEPTEMBER.																																						
From 55° to 60° north									0	0	---	---	---	---	---	---	---	---	---	12	3	3	4	4	3	3												
50° to 55° north									0	0	---	---	---	---	---	---	---	---	---	2	3	3	4	4	3	3												
45° to 50° north								3	4	4	4	4	4	3	2	2	4	4	2	2	2	2	2	2	3	3	3	3										
40° to 45° north	C	H	I	N	A		10	17	4	4	3	3	3	2	2	2	3	6	2	0	2	2	2	2	3	3	3	3		A	M	E	R	I	C	A		
35° to 40° north							6	6	2	2	3	2	2	1	1	2	4	2	2	2	7	7	3	3	4	4	5	5										
30° to 35° north							6	6	2	2	1	1	1	1	1	2	4	4	4	4	7	7	3	3	4	4	5	5	16									
25° to 30° north					2	2	0	0	3	3	2	1	1	1	1	2	5	5	7	1	2	2	2	2	1	1	4	4	6	6	11							
20° to 25° north			3	0	2	2	---	---	3	3	2	2	2	2	2	2	2	2	6	0	2	2	2	2	1	1	4	4	6	6	6							
15° to 20° north		12	1	1	2	2	1	1	4	4	3	3	2	2	2	2	2	2	2	0	3	3	2	2	7	7	8	8	8	8	6	0						
10° to 15° north		4	1	1	2	2	1	1	4	4	4	3	3	3	2	2	2	2	2	2	3	3	2	2	7	7	8	8	8	8	0	23	---	0				
5° to 10° north	0	2	0	0	3	3	8	4	5	5	4	4	5	4	4	5	5	6	5	5	2	2	2	2	1	1	0	0	0	0	0	0	5	5	1	1	18	
0° to 5° north	0	3	0	0	3	3	4	5	6	6	5	7	8	6	7	9	14	5	5	1	2	2	2	2	1	1	0	0	0	0	2	0	5	5	1	1	3	
0° to 5° south							4	10	12	16	14	12	18	16	7	5	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		
5° to 10° south							0	0	10	2	13	10	10	32	0	0	8	1	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	
10° to 15° south							0	0	0	0	5	0	0	15	0	0	0	1	0	0	3	4	0	0	0	1	0	3	0	0	0	0	0	0	0	0	2	
15° to 20° south												0	0	0	0	1	6	2	5	0	2	4	5	0	0	0	0	6	6	9	0	0	0	0	0	0	0	6
20° to 25° south											0	0	10	2	4	4	0	1	4	2	4	2	1	3	0	0	0	0	10	18	4	15	3	1	8	2	2	10
25° to 30° south		A	U	S	T	R	A	L	I	A	2	0	1	2	3	0	0	4	2	1	1	0	2	0	0	6	0	0	4	0	9	0	10	2	10	12	6	6
30° to 35° south											4	5	12	1	2	8	2	4	4	4	1	5	6	4	0	0	25	3	0	1	0	2	5	5	2	4	4	4
35° to 40° south							0	2	7	11	3	0	3	0	0	8	0	6	2	0	0	1	2	2	0	15	0	0	0	1	0	0	4	1	2	4	3	5
40° to 45° south							1	1	2	2	0	1	0	0	9	5	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	8	4	0	3	3
45° to 50° south							0	0	0	0	2	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	

Table showing the chances of calms—Continued.

LATITUDES.	LONGITUDES EAST.																LONGITUDES WEST.																					
	From 100° to 105°.	From 105° to 110°.	From 110° to 115°.	From 115° to 120°.	From 120° to 125°.	From 125° to 130°.	From 130° to 135°.	From 135° to 140°.	From 140° to 145°.	From 145° to 150°.	From 150° to 155°.	From 155° to 160°.	From 160° to 165°.	From 165° to 170°.	From 170° to 175°.	From 175° to 180°.	From 180° to 175°.	From 175° to 170°.	From 170° to 165°.	From 165° to 160°.	From 160° to 155°.	From 155° to 150°.	From 150° to 145°.	From 145° to 140°.	From 140° to 135°.	From 135° to 130°.	From 130° to 125°.	From 125° to 120°.	From 120° to 115°.	From 115° to 110°.	From 110° to 105°.	From 105° to 100°.	From 100° to 95°.	From 95° to 90°.	From 90° to 85°.	From 85° to 80°.	From 80° to 75°.	From 75° to 70°.
OCTOBER, NOVEMBER, DECEMBER.																																						
From 55° to 60° north																																						
50° to 55° north																																						
45° to 50° north																				0	2	2	3	3	0	0	0	0										
40° to 45° north										7	3	2	1	1	1	2	1	3	2	0	3	4	3	3	0	0	0	0		A	M	E	R	I	C	A		
35° to 40° north			C	H	I	N	A				2	1	1	1	1	2	2	2	3	0	2	2	2	2	2	2	5	5										
30° to 35° north									0	0	0	0	0	1	1	2	3	3	3	2	2	2	2	2	2	2	5	5	4									
25° to 30° north					30	---	---	---	0	0	0	0	0	0	2	2	3	3	3	6	3	3	4	4	4	4	3	3	3	3								
20° to 25° north			1	1	2	2	4	4	0	0	0	0	0	0	1	1	2	2	2	0	3	3	4	4	4	4	3	3	3	3	7							
15° to 20° north			1	1	2	2	4	4	0	0	0	0	0	1	1	1	2	2	2	1	5	5	0	0	1	1	1	1	4	4	9	9	12					
10° to 15° north		2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	2	2	2	0	5	5	0	0	1	1	1	1	4	4	9	9	5	3				
5° to 10° north	12	4	3	3	2	2	3	3	0	0	0	0	1	0	1	2	5	5	5	0	4	4	4	4	2	2	3	3	2	2	2	2	2	2	1	1	8	
0° to 5° north	2	5	3	3	2	2	3	3	0	0	0	0	0	0	0	2	5	5	5	0	4	4	4	4	2	2	3	3	2	2	2	2	2	2	1	1	12	
0° to 5° south											0	0	0	11	4	5	11	6	3	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
5° to 10° south							30	---	---	---	28	12	9	0	10	12	8	38	2	3	4	6	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	
10° to 15° south												8	10	2	0	0	1	5	1	0	5	9	1	4	1	0	0	0	0	0	0	0	0	0	0	0	2	
15° to 20° south												0	0	4	0	0	8	2	4	2	2	3	2	6	0	0	0	6	6	0	0	0	0	2	0	0	1	10
20° to 25° south		A	U	S	T	R	A	L	I	A		4	0	0	0	0	1	2	6	3	3	5	6	0	0	15	0	0	8	12	0	20	0	12	8	3	4	1
25° to 30° south												3	11	0	0	4	3	4	3	2	9	4	3	0	4	6	0	2	2	12	2	2	0	14	11	1	1	3
30° to 35° south											6	1	2	10	3	4	2	3	3	3	3	2	8	0	6	4	0	3	5	6	6	2	11	6	8	5	4	6
35° to 40° south							1	3	5	1	2	5	7	10	10	8	0	3	3	4	5	3	8	0	0	6	0	2	6	2	1	1	0	5	2	4	3	4
40° to 45° south							1	1	1	3	2	0	0	0	11	5	5	4	1	2	2	4	3	4	3	3	3	0	3	0	0	1	1	6	5	3	3	6
45° to 50° south							0	2	2	2	7	0	0	0	1	1	0	3	0	5	3	2	2	4	0	1	0	10	1	0	1	0	1	2	5	2	2	

Region of calms.— A clearly defined region of calms exists between the two sets of trades in the eastern part of the Pacific. These calms are termed equatorial. The zone in which the navigator is most exposed to detention from calms takes the form of a wedge, the base resting on the coasts of Guatemala and Mexico, between 5° and 25° N., and the apex extending to the westward as far as 105° W. to 110° W.

In January, February, and March, calms are common on the western coast of America from the equator to 20° N. Vessels making passage east of 105° W., will find a calm belt from 5° to 20° wide, when they will be liable to from four to six per cent. of calms.

West of 105° W. the calm belt may be said to cease, and west of 110° W., vessels usually pass from one set of the trades to the other without being appreciably detained.

In April, May, and June, navigation on the Mexican coast, from the gulf of Tehuantepec to cape Corrientes, is almost impossible for sailing vessels. The calms in this locality often last for several successive weeks.

In July, August, and September, the equatorial calms are of greater duration and prevail north of 10° N. They extend as far north as the 30th parallel.

In October, November, and December, a calm belt extends on the Mexican coast from 10° to 20° or 25° N.

Farther to the westward several calm regions exist, but they have none of the attributes of genuine *calm belts*. Equatorial calms also exist in the west Pacific, especially between the equator and 10° S.; in the central Pacific, however, though the numerous groups of islands interrupt the trades, calms rarely prevail to any great extent.

Beyond this wedge of calms there lies another wedge of variable and light winds. The calm wedge as a fixture rarely extends west of from 105° to 110° W.

The variables in *January, February, March, and April*, are between 105° and 110° W.

In *May* from 105° to 115° W.

In *June* from 110° to 120° W.

In *July and August* 110° to 140° W.

In *September* 110° to 120° W.

In *October and November* 105° to 115° W.

In *December* 105° to 110° W.

Beyond these limits the trades blow into each other.

This variable wedge varies from 2° on the west edge to 5° near the calms and lies from 3° to 10° N. in the months of June, July, and August, being farthest north.

Tropical calms—Trade winds.—Tropical calms are those which prevail on the polar borders of the trades. The calms of the tropic of Cancer are only well defined in the eastern part of the Pacific, and during the months comprised between April and September. They are common between the parallels 30° and 40° N. East of Japan, however, and between the same parallels, the calms are of greater duration, except during October, November, and December.

The calms of the southern hemisphere, near the tropic of Capricorn, are especially prevalent from October to April. During this season they occupy a belt extending over nearly the whole breadth of the Pacific, and reaching from 25° to 40° S.

During the rest of the year they are not comprised in so well defined a region. But it is important to note that in the eastern portion tropical calms exist at all seasons in a more marked manner, and have a greater width in latitude, appearing to increase on approaching the coast of America.

Later will be given, in the descriptions of the various routes, more detailed information on the chances of detention by calms.

§ 2. **Trade winds.**—The limits of the trades cannot be laid down by any absolute rule, as in the same month and from year to year the reports show a difference of 600 and even 900 miles between the mean limits and those found, but the following table is given to cover the usual limits, within which we may expect to find them.

Northeast and Southeast trades.—The NE. trade winds of the Pacific blow in the northern hemisphere from the NE. and ENE. and are usually stronger than the Atlantic NE. trades. See table for limits § 3.

The NE. trades do not begin to be well defined within 300 miles of the western coast of America. On coming closer to the coast variable winds are found, according to the season of the year. (§§ 23 and 24.)

Though the western limits of the NE. trades can hardly be definitely fixed, it is generally conceded that these winds extend, all the year round, as far as the Caroline and Mariana islands. Monsoons prevail westward of these groups. (§ 4.)

Finally, the NE. trades of the Pacific attain their greatest force while the sun is in the southern hemisphere, or, in other words, from October to March. This remark applies to all trade winds, for they are always stronger when the sun is in the opposite hemisphere; when the sun is in their own hemisphere, they are, on the contrary, always weak, baffling, and often changed to monsoons blowing from an opposite direction.

Southeast trade winds.—The SE. trades are especially prevalent in the eastern part of the Pacific. See table for limits, § 3.

The SE. trades are much less regular than the NE.

Settled SE. winds will be found from 250 or 300 miles off the coast of America to 108° or 118° W., while west of these meridians the wind shifts to East and ESE. Beyond 138° W. the trades become exceedingly variable, undergoing such changes, especially from

October to April, that some authors consider them to possess all the characteristics of genuine monsoons.

This question will be considered in the second part of § 4.

§ 3. **Table of trade-wind limit.—**

Month.	Northern limit of NE. trade.	Southern limit of NE. trade.	Northern limit of SE. trade.	Southern limit of SE. trade.
January	35° N. 122° to 165° W.	5° N. 110° to 165° W.	5° N. 110° to 135° W. 0° to 3° NW. of 135°	30° S. 80° to 160° E.
February	30° N. 122° to E. long.	5° N. 110° to E. long.	5° N. 110° to 150° W. to Wd. variable	35° S. 80° to 160° E.
March	30° N. 122° to E. long	5° N. 110° to E. long	5° N. 110° to 180° W	30° S. 80° to 170° E.
April	30° N. 122° to E. long.	5° N. 110° to 140° W 0° 140° to E. long	5° N. 110° to 140° W. 0° 140° to E. long.	32° S. 80° to 170° E.
May	33° N. 122° to E. long.	8° N. 110° to 160° W 0° 160° Westward	8° N. 113° to 160° W. 0° 160° Westward	34° S. 80° to 170° E.
June	35° N. 122° to E. long.	10° N. 115° to 145° W. 8° N. 145° to E. long.	8° N. 110° to E. long.	30° S. 80° to 150° W. 35° S. 150° to West'd.
July	40° N. 122° to E. long	10° N. 115° to E. long	10° N. 115° to E. long	30° S. 80° to E. long.
August	40° N. 122° to E. long.	12° N. 115° to 145° W. 10° N. 145° to E. long.	10° N. 115° to E. long	28° N. 80° to 170° E.
September	38° N. 122° to E. long	10° N. 115° to E. long	10° N. 110° to E. long	30° S. 80° to 170° E.
October	35° N. 122° to E. long	10° N. 113° to E. long	10° N. 105° to E. long.	38° S. 80° to 100° W. 30° S. 100° to 170° E.
November	33° N. 122° to E. long	8° N. 113° to E. long	8° N. 110° to E. long.	35° S. 80° to 100° W. 30° S. 100° to 170° E.
December	32° N. 122° to E. long	5° N. 110° to E. long	5° N. 110° to E. long.	35° S. 80° to 95° W. 30° S. 95° to 170° E.

§ 4. **Prevailing winds of the west Pacific.**—Information concerning the prevalent winds north of the line is far from being complete; consequently too much confidence must not be placed in the following remarks:

NE. winds prevail in the west Pacific from October to April. Though called the NE. monsoon, they are in reality only the steady trade winds. Near the Caroline islands the NE. monsoon does not set in steadily until December, while north of this group and among the Mariana islands it sometimes begins in November and lasts till May or June; in short, the duration of the monsoon varies considerably. The NE. winds are generally accompanied with good weather.

All authorities agree in stating that steady SW. winds prevail from April to October; near the Philippine islands, from May to September, and in the Mariana group, from July to August, they are especially common. This is the rainy season in these localities. SW. winds are frequent in the neighborhood of the Bonin islands from April to July, but too much reliance must not be placed on the chance of meeting winds from this direction in the western portion of the north Pacific; and even in the neighborhood of the Mariana and Caroline groups, due allowance should be made for variations in the SW. monsoon.

South of the Equator.—In § 2 we stated that the SE. trades are unsettled to westward of 138° W.; this is especially the case from October to April.

The winds are very variable from October to April, throughout the region included between 138° W. and about 170° E., and from the equator to 25° S.

Westerly winds are here nearly as frequent as easterly winds; that is, the squares on the wind chart, where the westerly winds predominate, are almost as numerous as those containing winds from an opposite quarter. It follows, therefore, that at this season passages from west to east are made under sail with less difficulty than during the rest of the year.

Monsoons.—The NW. monsoon prevails, at this season, to the westward of about 170° E.; and from the equator or 1° N. to 15° S., or even 19° S. This monsoon begins in October, with winds shifting from North to NW., and from West to SW., accompanied by storms, calms, and rain. The west winds begin to be regular after the month of November and last until March. The NW. wind, or rather NW. monsoon, prevails, during January and February, along the coast of New Guinea and the adjacent islands, and extends to 170° E., but after March the direction of the winds again varies considerably.

Storms.—It can be stated in general terms, that the bad season of the whole extent of the south Pacific, west of 138° W., lasts from October to April; the weather is then rainy and stormy and the wind exceedingly variable. Storms are common at this season between 10° and 25° S., and commence as simple squalls, the wind not changing in direction. The worst gales are from November to April, but fortunately they are of rare occurrence. See § 25 on revolving storms.

The good season of the south Pacific lasts from April to October. The trades are then found to westward of 138° W. They are, however, variable for different localities, shifting from SSE. to East, and even to NE. Voyages from east to west are then easily made. Even at this season, however, the winds are scarcely ever steady and strong from SE., except in the extreme west of the Pacific, near the New Hebrides, Solomon, and New Guinea, during the months of June, July, and August. In these quarters the SE. trades may be justly termed the SE. monsoon, in contradistinction to the NW. monsoon, which begins to blow there in November. The change occurs during September and October. In September the SE. winds blow gently. In October squalls and variable westerly winds set in.

§ 5. **Zones of westerly winds.**—General westerly winds are encountered at some distance beyond the polar limits of both sets of trades, the trade-wind limit itself following the changes in the sun's declination. Two principal antagonistic currents in the atmosphere—called *polar* and *tropical* winds—exist in the region of variables. A rotary movement in the atmosphere is produced by the meeting of these currents, causing revolving storms.

Navigators at the present time are, however, a little too apt to fall into the error of imagining that every storm they encounter is a cyclone. This remark is especially applicable to the Pacific, where real circular storms, with the exception of those to be mentioned in § 25, are very rare.

Warnings which precede polar and tropical winds.—In either hemisphere the wind from the direction of the adjacent pole is cold, dry, and squally; while the wind from the equator, or tropical wind, is warm, damp, and rainy. Thus, when the wind is blowing from SW., in the northern hemisphere, and the sky shows signs of clearing to the NW. or North, while at the same time the thermometer falls, and the deck, sails, and rigging dry rapidly, it follows that the wind will come out from NW. and North. These signs are verified by a rise in the barometer.

The same rule applies for the southern hemisphere, when the wind is from NW., and the sky is inclined to clear from the SW. or South, the wind then of course shifting to the southward.

On the other hand, the North, NE., and East winds of the northern hemisphere will change to SE., South, and SW., when the sky becomes overcast to the southward, the weather warmer, and the deck, rigging, etc., covered with dampness; while at the same time the glass falls.

The corresponding changes for the southern hemisphere are from South to East, and then to the northward and westward, with the northern horizon overcast.

In spite of their apparent irregularity, the so-called variable winds follow a general law in all their changes of direction. In the northern hemisphere they all rotate with the hands of a watch, thus W. ↻ E.; in the southern, their rotation is in a contrary direction, thus, W. ↺ E. When, as sometimes occurs, the winds act contrary to this law of rotation, they are said to back; and in such an event it is prudent to take precautions against bad weather, and to watch the barometer and the horizon.

A fact of equal importance, and one well known to sailors, is, that when the westerly winds are well from the southward in the northern hemisphere, or well to the northward in the southern, they do not attain much strength until they have blown for some time. On the contrary, the shifts of wind toward the adjacent pole are generally quick, and the subsequent weather bad. On this account it is advisable for vessels encountering bad weather from the SW., in the northern hemisphere, to lie to on the starboard tack, in order to guard against sudden changes of wind from SW. to NW. On the port tack they would be liable to be taken aback, and their spars endangered.

In the southern hemisphere, on the other hand, with bad weather from the NW., it is advisable to lie to on the port tack in order to keep the sails full when the wind shifts violently from NW. to SW.

Observations of Captain Prouhet, on the usual course of storms in the southern hemisphere, (Ann. Hydr., vol. 31):

"Besides numerous gales, we experienced continued bad weather, while in the high latitudes of the Pacific.

"The SE. gales began and ended at nearly the same compass point; the wind blowing furiously, but scarcely ever changing more than from 4 to 6 points; SSE. and East were the extreme limits. At times the wind sprang up, increased, and died away from the same point; at others, it shifted to East before falling, when it quickly fell calm

"The shifts of wind did not take place as they should, from the northward to westward; the gales, on the contrary, being preceded by a retrograde motion of the wind. If the wind, after shifting from West or NW. toward North, got as far round as SE., and the horizon became overcast, a southeaster was almost sure to follow. The wind very rarely shifted in a contrary direction as far as East, for when it reached the SE. point it died away altogether, and afterward sprang up from NE., blowing a gale. In passing to the northward it increased slowly, blowing violently when it reached the NW. point; after having blown from this direction for a little while, it inclined toward West and SW., and sometimes suddenly shifted to the latter point. Here the squall was at its worst, though it fortunately lasted for only a short time. If it continued to rotate toward South the weather quickly cleared, and the wind abated; though a gentle breeze from South and SE. could be expected for a day or two. But, now and then, the wind did not even follow this law, and backed again toward the westward, after the first burst from the SW. In this case the wind returned with fresh vigor, after a considerable interval, during which numerous gusts showed that this was only a lull in the violence of the storm. After this the wind always came out very strong from SW.

"The squalls, which afterward blew fiercely from the West and SW., began generally from the West and NW., with gusts, fog or rain; they grew violent from SW., and continued to increase, swinging slowly round to the southward, ending at the SE. in furious blasts. Throughout they were more a succession of violent shocks than a steady gale. At times there were intervals during which the weather moderated and seemed on the point of clearing; but these lulls were followed by renewed squalls from SW., which blew with redoubled violence. Each new blast drew nearer to SE. than the preceding ones, until having finally reached this point the wind died away without returning to the southward; in fact, it more often fell after reaching East. We encountered these "bursters" in quite high latitudes for variable winds; between the latitudes 56° and 45° we were driven before one for five days."

§ 6. **Prevailing winds on the coast of Australia.**—On the NW. coast of Australia, between Melville island and cape Northwest, the winds are irregular from March to December. But in summer, that is to say, from December to March, the land breezes are steady from East to NE., and the sea breezes from SSW. to SSE. The usual winds prevail along this coast. From October to April, the west monsoon, with variable gusts from SW. and NW.; from April to October, the east monsoon, with variable winds from East and SE., when the dry season commences. These laws hold as far as the tropics; but on going farther south, from cape Cuvier to cape Leeuwin, the prevalent winds are from NW. to SW. The northerly winds blow only for short periods, but are excessively warm; those from NW. are common and often violent in the vicinity of cape Leeuwin. Next to the NW. winds the SW. are the strongest. In short, this part of the coast of Australia is exposed to very heavy winds and seas; the vapor in the atmosphere is condensed on approaching the coast and causes showers, squalls, and bad weather, particularly during the rainy season, from May to October. Land breezes from East and NE. are common during the summer months, while in with the land sea breezes prevail from West and SW. The latter are particularly to be noticed in December, January, and February.

The South coast.—North of a line drawn from the Recherche islands to capes Northumberland and Bridgewater, regular land and sea breezes, varying from SE. to ENE., may be expected from the 15th January to the 15th April. During this season stiff blows are sometimes met with, which, in case of their shifting to SW., become violent. During the remainder of the year the prevalent direction of the wind to northward of the line given above is West.

Westerly winds prevail in the offing at all seasons, especially from April to November, when stiff gales, with a high sea and heavy swell setting to the eastward, are found. The gales usually begin from NW., and after an interval shift suddenly to SW.; frequently they work back to NW., following the general law given in the preceding section.

During the summer, particularly in February, there will sometimes be an easterly wind favorable to vessels making passage from cape Otway to cape Leeuwin. Still it would not be advisable to count upon such a wind.

The East coast.—Dry weather and west winds prevail during the winter months, from May to September, from Bass strait to Sandy cape; rain and warm NW. and North winds are, however, quite frequent. Well off the coast the weather is bad, and the prevalent wind from NE. to South.

During the summer months the wind on this part of the east coast is usually from SE. and the weather fine. The land breezes near the shore increase in steadiness near the tropic; but while running to the southward, past cape Howe, navigators should be on the lookout for southerly and southwesterly squalls and strong winds from North to ENE., followed by rainy weather. The warm NW. summer winds of the east coast generally terminate in a sudden shift to SE. and SSW. A description of the prevalent winds of the coast from the tropic of Capricorn to Torres strait will be found in § 4. From the end of April to September the wind is SE., while during the remainder of the year the NW. monsoon prevails, with its accompanying bad weather, rains and variable winds.

The following quotation is taken from the Ann. Hydr., vol. 31:

Southerly bursters or brickfielders.—"Strangers sailing along the east coast of Australia should take every precaution against the tornadoes called 'southerly bursters,' which are common during the summer months. They generally set in after the ordinary NE. winds and blow a gale for from two to twelve hours. If the weather be clear, the wind NE., and black thunder clouds and forked lightning are noticed to the SW., the barometer falling, it is necessary to shorten sail, for the wind, after blowing very stiffly from NE., will die away calm, and then after a few moments' calm come out from South with great strength. After having blown from two to twelve hours it will pass from South and SE. to East, after which the usual summer wind will set in with a rising barometer. Sometimes the wind blows violently from the South for two or three days, afterward veering from East to NE.

"Dangerous squalls may also be expected from NW. These winds are warm, accompanied by thick clouds charged with electricity, the barometer being low; they shift abruptly from West to SSW. and South with lightning and occasional rain, and blow violently for a short time. Forked lightnings on this coast invariably indicate more wind, or a sudden change of wind from the quarter in which it lightens, or at least unsettled weather.

"The winter squalls generally come from the West with a clear sky and blow furiously for two or three days, commencing at NNW. and passing to the westward with a low barometer. The barometer. rises after the wind reaches SW., and the force of the storm gradually abates. Sometimes the wind jumps from NW. to SW., with a loss of strength.

"The easterly squalls are the most dangerous for strangers; they begin from SE. with the barometer at $30^{in}.00$ and overcast weather and heavy swell from the eastward; they pass from East to ENE., then return to East and ESE., blowing with great violence, accompanied by rain and a heavy cross sea. They last from twenty-four to forty-eight hours. Sometimes they begin with gloomy and overcast weather, light baffling winds, and easterly swell, and forked lightning from all points of the compass. In this case vessels should put to sea to await good weather."

§ 7. **Prevailing winds in Bass strait.**—West and SW. winds prevail in this strait the whole year round. The winds are generally strong and the squalls frequent. The latter begin at NNW. with the barometer falling from $29^{in}.92$ to $29^{in}.68$, and even lower, they become very strong in shifting to West and SW. When they back from SW. and West, toward NW., the weather generally becomes worse. January, February, and March are the only months during which a vessel may pass through the strait with a favorable easterly wind. When these winds blow the weather is ordinarily fine.

In conclusion, the system of winds is here the same as that of the south coast of Australia, described in the preceding section. But at the eastern entrance of the strait, and east of Van Diemens Land, the winds are similar to those of the east coast of Australia, also mentioned in § 6. It is necessary to be extremely cautious against squalls from SW. to SE., especially those from the latter point. NE. winds are also common, but never attain any great strength.

§ 8. **Prevailing winds on the coast of New Zealand.**—New Zealand includes three large islands: North, South, and Stewart. The northern and middle islands are separated by Cook strait; the middle and southern by Foveaux strait.

North island.—On the east coast the weather generally moderates in summer. At this season, from cape North to cape East, the sea breezes blow regularly from NE. during the day; and the land-breezes from west during the night. On this part of the coast the winter winds prevail from NW. to SW.; they also blow strongly from NE. and NW., shifting at the end of twenty-four hours toward WSW. and SW. with clearing weather. The SE. winds are very cold, being frequent and violent near cape East. Between cape East and Cook strait squalls are common in winter from SE. and South; the climate, however, is good on this part of the coast.

On the west coast of North island the winds are steady from NW. to SW. during the year. In winter the NW. wind is naturally rainy. The most violent squalls are in the spring and autumn. The great rains take place in July, August, and September; fogs are frequent in October and November, particularly in the morning.

Cook strait.—In this strait it is almost always windy either from the NW. or SE. On approaching the strait the wind is nearly always from one or the other of these directions. It frequently blows a gale from NW. or SE. In crossing, the wind often shifts from cape to cape, especially on leaving the strait. There is then danger of being taken aback, and it would be advisable for steamers under sail to light their fires. April, August, November, and December are months of comparatively good weather. SE. winds preceded by a fall in the barometer are most frequent in winter, (May, June, and July); at this season it is not advisable to pass through the strait from west to east. Violent squalls from NW., with a very high barometer, occur oftenest in spring and summer, from September to March.

Middle island.—The best months on the eastern coast are December, January, February, and March; winter is the season for squalls and rain, especially in June, July, and August.

In summer, from December to April, NE. winds are common during the day; land breezes do not blow steadily at night. In winter, NW. squalls blow sharply and with great force; they are preceded by an unusual clearness of the atmosphere, and by a falling barometer; like the sirocco of the Mediterranean, they cause an increase of ten degrees in temperature. Squalls from SSE. and SSW. are preceded by a falling barometer, which rises as soon as they begin. They make overcast weather, and in winter bring rain; in spring and autumn they are accompanied by strong gusts, hail, and sleet. On the west coast of Middle island the prevailing winds are from NW. to SW. The NW., bringing rain and cloudy weather, hauls often to the North on nearing land. Rains are frequent on this coast. The SW. winds prevailing in summer are fine and clear. Vessels coming up the coast from Foveaux strait have to encounter a southerly current, and steady winds from NW. and NNW. until they have doubled cape West.

Foveaux strait.—Strong winds from NW. to SW. blow here almost incessantly, particularly from the former point, accompanied by cloudy, rainy weather. It often happens that the wind blows from SW. on the eastern coast of Stewart island, and from NNW. on the western coast at the same time. The NW. wind is preceded by a falling barometer, and at the end of several days usually shifts to SW., with a rising barometer and clearing weather. The worst storms in this strait occur in July.

Occasionally heavy SE. winds enable vessels to pass through the strait from east to west. These may be foretold by a rise in the barometer and a long strip of clouds in the SE., and a light haze over the mountains and horizon. These winds are frequently violent and bring a drizzling rain and overcast weather.

§ 9. **Prevailing winds in New Caledonia.**—The wet season lasts four months, from the end of December to April; rain is then frequent, particularly when the wind blows from ENE. to WSW. and shifts by the north point of the compass. The other eight months of the year are the dry season.

In the southern part of the island the winds during the winter are irregular and variable, often blowing very strongly; particularly in January and February (see note on revolving storms, § 25), when storms are to be feared. In the northern part the trades blow from

SE. and ESE. nearly the whole year, except in September and October, when one is particularly exposed to violent westerly storms, preceded by lowering, foggy weather, and a dead calm.

To the southward of the island the ESE. trade winds prevail, especially during the eight months of the dry season. NW. and West winds are frequent in the neighborhood of Noumea. They blow freshly for several hours, accompanied by rain, and preceded by a barometer at between $29^{in}.68$ and $29^{in}.80$; the wind afterwards shifts to SW. and South, with clearing weather. When there are NW. winds in the vicinity of Noumea, it frequently blows from SE. in the eastern part of the island and in Havannah channel. Inversely, the wind is often from NW. in the SE. part of the island, while it is blowing from SE. near Noumea.

In conclusion, the trade winds are especially prevalent on the east coast; in June and December they occasionally blow violently.

If at this time the barometer falls, look out for heavy squalls and driving rain. A continued fall of the barometer indicates a change of the wind to North and NW., whence it will blow with great strength for several hours. Afterward, as we have already said in speaking of Noumea, it will pass to SW. with clearing weather.

§ 10. **Prevailing winds in the Society islands.**—The Society or Tahiti group are situated in that part of the west Pacific where, as we have already stated in sections 3 and 4, the SE. trades do not blow with regularity.

In the eastern part the winds ordinarily prevail from SE. to East and NE. during the whole year; they are now and then interrupted by breezes from West and NW. These winds are frequently rainy, and blow strongest during April, May, and June. Rains are to be expected also in November, December, and January. When the SE. trades blow strongly it also rains at times.

The trades blow in January, February, and March, but they vary greatly in direction. There are seven to ten per cent. chances of calms during these three months. In April, May, and June the chances of calms are from five to six per cent.; westerly winds are frequently felt in April; in May they blow steadily from West and NW.; in June the trades are prevalent, though still frequently interrupted. In July, August, and September there are only four to five per cent. of calms; and the trades, though very variable, steadily increase. In September, October, and November they are steadier than at any other time. For the last quarter of the year the table in § 1 indicates only from two to three per cent. of calm chances.

§ 11. **Prevailing winds in the Marquesas islands.**—In the Marquesas group the trades, from April to October, blow from ESE., varying at times a few points to the southward or eastward. During the other six months of the year they often haul to ENE. and even to NNE.

When the wind passes the north point and comes out from NNW. the weather is squally.

It often rains in torrents during May, June, and July, and is windy and squally from South and SSW. In January it rains hard, and violent NW. gales are then common.

Most of the bays, particularly the harbor Taiohae, are completely sheltered from the prevailing winds. It is extremely difficult for sailing vessels to enter or leave these bays, and they are often obliged to be towed by their boats, or at least to have them in readiness in case the vessel is taken aback by baffling breezes. Vessels with auxiliary steam power will, however, experience no difficulty in coming to anchor or leaving the harbors, as the shore is high and steep-to.

§ 12. **Prevailing winds in the Hawaiian islands.**—During the entire year the trades prevail from NE. The rainy season is from November to May; during which period occasional NW. and SW. gales occur. In the Hawaiian group the chances of calms never amount to more than from two to three per cent.

Land and sea breezes blow on the western coast of Hawaii.

§ 13. **Prevailing winds in the Java sea.**—The Java sea is bounded on the north by the islands of Borneo and Celebes; on the south by the islands of Java, Bali, Lombok, Sumbawa, Sapi, and Flores. It communicates with the China sea by the straits of Banka, Gaspar, and Carimata; with the Celebes sea by the strait of Makassar, and with the Indian ocean by the straits of Sunda, Bali, Lombok, Allas, Sapi, and Flores.

In the Java sea two monsoons prevail; the SE., though frequently interrupted by calms, begins in April, becomes strong in May, and ends in October. During this month of transition calms occur. The NW. monsoon commences during the first fortnight of November, blows with full force in December, and lasts till the end of March. In April the winds are again light, accompanied by showers and squalls.

§ 14. **Prevailing winds in the Banda, Timor, and Molucca seas.**—The Banda sea is bounded on the north by the islands of Bouro, Amboina, and Ceram; on the south by the islands of Flores, Pantar, Ombai, Serwatti, and Timor Laut. The Molucca sea, situated to the north of Bouro and Ceram, is bounded by Waigiu, Gillolo, and Celebes; it communicates with the Pacific by Pitt, Gillolo, and Dampier straits. The Timor sea stretches from Timor, Serwatti, and Timor Laut, on the north, to Melville island and the coast of Australia on the south. Here the monsoon generally blows from WNW. from October to March, and from ESE. from April to September. The latter is called the SE. monsoon (notwithstanding the fact that it blows from nearer East than South). It begins during April, and toward the end of May has set in steadily at Amboina, Ceram, and

Banda islands, when it corresponds to the rainy season; but it is well to remark that, even at this season, the weather is always good at Bouro island. Between Bouro and Ceram the SE. monsoon is sometimes very fresh.

The NW. monsoon generally brings squalls, overcast weather, rain, and easterly currents.

Molucca sea.—Here the NW. monsoon sets in during the first two weeks of November, and blows strongly from December to March. Then the transition period begins, with variable breezes, calms, squalls, and rain. In April we have the SE. monsoon, which prevails from May to the end of September. In October the transition period is repeated.

In the passage between Celebes and Gillolo the general direction of one monsoon is NNW., and of the other SSE. At times these directions are the same in Gillolo strait; but the monsoons do not blow at all regularly in this strait, and still less so in Dampier and Pitt straits; vessels can consequently often pass through against the monsoon.

Timor sea.—The westerly winds are prevalent from October to April, with squalls from the Banda sea. This monsoon extends to 15° or 16° S. and hauls toward the SW. The SE. monsoon sets in during the last of May, and lasts, in the neighborhood of Timor, until the 15th of November.

§ 15. **Prevailing winds in the Sulu and Celebes seas.**—The Celebes sea is bounded on the south by the northern coast of Celebes, on the west by NE. coast of Borneo, on the north by the Sulu and Mindanao islands, and on the east by the Sanguir, Saddle, etc., chain of islands.

The Sulu sea is bounded on the south by the Sulu islands and the north coast of Borneo, on the west by Palawan, and on the east by the Philippines.

In the Celebes and Sulu seas the easterly monsoon is variable in October, though blowing strongly from NE. and East from November to April. During the last days of May the westerly monsoon commences; it is very variable, both in strength and direction, with squalls and rain. In June it is well established, in July rainy and stormy, ending in September.

§ 16. **Prevailing winds in the Arafura sea.**—The Arafura sea lies between the northern coast of Australia and the southern coast of New Guinea; it is bounded on the west by the islands of Arru and Timor Laut, and on the east by Torres strait.

In the Arafura sea the westerly monsoon brings the rainy season, when thunder storms are violent and frequent. Captains having a proper regard for the health of their crews or passengers will avoid the locality at this season. Toward the end of December the NW. or West winds are strong and regular; in February and March they commence to be variable. During the latter month the weather is often gloomy and overcast, with a variable wind from SW. After the beginning of April the winds are from SE. and East; they become settled after eight or ten days of storm and rain. From May to August the monsoon blows strongly from the ESE. to SE., and lasts irregularly until the month of October. In November the winds are uncertain and the calms frequent, until in December the westerly monsoon sets in.

§ 17. **Prevailing winds in the China sea.**—The SW. monsoon prevails in the China sea from the 15th of April to the 15th October. It is variable in force and direction, especially in May; on the south coast of China it is sometimes interrupted by a series of winds from South and SSE., and by winds from East and SE., especially in the northern part of the China sea.

Near Formosa and Formosa channel it is not uncommon to find winds from North to East during the months of July, August, and September, but it is not well to rely upon this chance.

The SW. wind is first felt in the neighborhood of the gulfs of Siam and Tonquin, toward the middle of April, but the true monsoon does not reach its full force until June, July, and August, when it brings dull and rainy weather. It should also be borne in mind that typhoons are frequent during these three months.

Violent squalls preceded by heavy clouds coming from the gulf of Siam are dangerous, as far as pulo Sapatu, from May to September.

Strong squalls, rotating from NW. to WSW. and South, and accompanied by heavy rain, are also frequent at this season off the gulf of Tonquin.

"*Borneos.*"—Commencing from the SW., they shift to West and NW.; consequently, if well clear of the coast of Borneo a captain can use them to make to the southward on the starboard tack.

Vessels coasting from the gulf of Siam to cape Padaran between May and September meet with light land breezes at night; slight calms in the morning and a steady monsoon from SW. during the day. This is especially the case beyond cape Padaran, and as far as the gulf of Tonquin. Instead of the SW. monsoon, a genuine sea breeze often blows from SE. during the day, alternating with light land breezes at night.

The SW. monsoon, which first becomes settled in the southern part of the China sea, lasts longer in this region than in the northern part. Thus during the month of September and a part of October strong breezes from SW., bringing overcast, rainy weather, are often found at the entrance of Balabac strait. Southerly winds frequently prevail between Singapore strait and pulo Sapatu from the 10th to the 15th of October, while NE. and East winds are common in the northern part of the China sea.

Northeast moonsoon.—The NE. monsoon begins in the north of the China sea toward the end of September or the beginning of Octo ber; but to the southward of pulo Sapatu and off the western extremity of Palawan it seldom sets in before the month of November, on account of the greater persistence in these quarters of the variable southerly winds which end the SW. moonsoon.

Although the SW. winds blow in September, they have to contend against variable breezes from NE. to East and SE. This state of things continues till the October full and change, at which time there is often a storm from SW., varying to West and NW. Then the wind passes to NNE. and NE., sometimes bringing with it the NE. monsoon. Some years the weather during September and October is fine, and the NE. monsoon is not always preceded by a squall. During these months strong winds from ENE. and NE. sometimes blow for several successive days, on the coast of China.

In November the NE. monsoon is generally established; it attains its greatest force and regularity in December and January. During these two months heavy rains and seas are found, especially between Singapore, pulo Condore, and pulo Sapatu. In October, November, and the commencement of December the weather is overcast and rainy; as the wind is variable it is possible at this season to sail either up or down the coast of Palawan. In February the NE. monsoon abates; in March it blows moderately; during these two months the weather is fine in the China sea.

Gulf of Tonquin.—The NE. monsoon prevails from the latter part of September to the first of April in the gulf of Tonquin and along the coast to cape Padaran; ENE. winds, shifting from NNE. to SE., are then common on the southern coast of China.

§ 18. **Prevailing winds on the coast of Luzon.**—On the western coast of Luzon the monsoon varies from North to NNE. from November to April. The winds at this season sometimes shift to NW. and West, blowing violently, and accompanied by rain. During March and April the weather is usually fine, with land and sea breezes. The SW. monsoon begins in May, becomes settled in June, blows with full force in July, and lasts until the end of September. From June to September the weather is usually overcast and very rainy. The monsoon begins to abate after the first of October, and soon after gives way to that from the NE.

The weather is fine on the eastern coast of Luzon during the SW. monsoon, from May to September, the rainy season occurring at different seasons on the eastern and western coasts of the island.

The monsoon blows quite as often from South as it does from SW.; winds are steadier during June, July, and August; during these months, however, there is frequently a series of winds from SE., NE., and NW. In April and May it blows quite as often from NE. and East as from SE., South, and SW. Finally, from the beginning of October to the end of March the wind is steady from NE., shifting only to NNE. and East.

Squalls.—Around the island of Luzon, and especially on the western coast, from June to October, and particularly during September and October, it is advisable to guard against strong squalls which begin from North and NW., shifting to West, SW., and South. Though fortunately of short duration they blow with great strength, producing a very heavy sea and rain.

§ 19. **Prevailing winds in the sea and islands of Japan.**—From January to March, inclusive, northerly winds prevail on the Korean coast, hauling to the westward in the middle of the Japan sea; on the coast of Siberia southerly and southwesterly winds prevail, and on the east coast of the Japan sea, westerly and northwesterly winds and calms are experienced.

From April to June, inclusive, the winds are variable, but light southerly winds prevail with frequent calms and fine weather, especially between the parallels of 40° and 45° N.; the wind hauls to the eastward on the coast of Japan, and is accompanied by mists; it, however, sometimes freshens to a stormy breeze with squalls from northeastward. Generally the weather is fine from July to September, inclusive, on the Korean coast; moderate northerly winds prevail, with fine weather in September.

Fogs prevail from April to August, inclusive, all over the sea of Japan, especially on the northern coast of Korea and coast of Tartary, and are most dense in June. Hazy weather generally accompanies fresh and extremely cold NE. winds or light southwesterly breezes. The latter not infrequently bring on a dense fog, particularly in the northern part of the east coast of Korea, though fogs as a rule are dispersed by a fresh breeze from the SW. Violent squalls occur at all seasons in the sea of Japan—gales from the SE. at the equinoxes; cyclones are not frequent, but a record of ten in one year shows the necessity of care.

The monsoons blow on the South, SE., and East coasts of Niphon from NE., from September to April, and from SW., with bad weather, gusts, storms, and water spouts, from June to September.

The transition period is from the 15th of May to the 15th of June, when rains are abundant. Typhoons are prevalent from July to November.

But it is not advisable to rely too much on the monsoons of these latitudes, for the prevailing winds in January, February, and March off the eastern coast of Japan are from NNW., West, and WSW.; and in April, May, and June, from South and SW., being very variable, and often hauling as far as East, NE., and NW. as they leave the coast. In July, August, and September variable winds, mainly from a SE. direction, are to be expected; close to the islands they blow from NE. and North, while out at sea winds from SW., South, SE., and especially East, are found. In October, November, and December the winds off the coast prevail from NE. and North, and especially from NW.; they also sometimes blow from SW. and South.

§ 20. **Typhoons of the China seas.**—Typhoons are circular storms which, though of short duration, are often extremely violent. Two or three typhoons may be encountered in one year, while during others not one will occur. (Consult § 25 on revolving storms.)

§ 21. **Prevailing winds on the coast of Chile.**—From the island of Chiloe, where it rains nearly all the year round, to 35° S., the winds are very variable in strength, but prevail from the westward. During the months of December, January, February, and March they blow frequently from SSW. to WSW.

The winds prevail from SE. to SW., between 35° and 25° S., during the dry season, which lasts from the middle of September to the end of May. During this period of nearly nine months the wind between 35° and 30° S. generally blows from some point between South and SW. Near the parallel 30° S. this direction of the wind changes to South or SE., but it is generally fixed between 30° and 25° S., at some point to the eastward of South. The weather from September to May is generally clear, and little rain falls; sometimes, however, it rains south of 31° S. for two or three successive days, with strong northerly winds.

Along the coast, between 35° and 25° S., the dominant southerly winds are often so strong that vessels close-hauled are obliged to take two reefs in their topsails. When the wind sets in strong from this direction vessels are often prevented from gaining an anchorage—Valparaiso, for instance—notwithstanding the fact that they may have sent down topgallant masts and close-reefed the topsails.

During the three months of the rainy season, from the end of May to September, calms, variable breezes, and bad weather are to be expected, as well as squalls from the northward with rain and a heavy sea on the coast and far out at sea.

In June the winds blow as often from North as from South between 35° and 30° S.; between 30° and 25° S. they prevail from South and SE. In July there are variable winds between 35° and 25° S.; they are nearly as frequent from the North as South, though the majority, perhaps, come from the SW. In August, from 35° to 30° S., the winds are variable, but prevail from South and SE.; between 30° and 25° S. the general direction of the wind is from SE. and SW.

The northerly winds of the rainy season rarely amount to a squall. At Valparaiso, from May to September (especially in June, July, and August), it is well to look out for northers.

Overcast weather, a swell from the north, and a falling barometer are certain indications of the approach of these storms, during which a large number of vessels have been driven ashore. During the good season the southerly winds in this roadstead are fresh enough to make vessels drag their anchors. Northers are felt along the coast, including the harbor of Copiapo, when at certain periods of the bad season they are sometimes tolerably strong from NW.

§ 22. **Prevailing winds on the coast of Peru.**—From 25° S. to cape Blanco and Guayaquil the wind blows all the year round from SE., varying from SSW. to ESE. The SE. wind becomes gradually steadier as the coast is left. Within 100 miles of the shore the winds partake more of the character of land and sea breezes.

The wind rarely blows at sea from SSE. and SE. with sufficient strength to make vessels by the wind take a second reef in their topsails.

To the southward of the parallel of 16° S., and near cape Blanco, or Nazca point, it reaches its greatest strength.

The weather often looks bad, but the squalls which follow are almost always to be weathered with single-reefed topsails and courses. At all seasons the winds vary in force and direction within 300 or or 400 miles of the coast; beyond this limit the trades are well established. But, from April to August in the zone comprised between 100 and 400 miles off the coast, the winds are particularly subject to changes. At this time, and particularly in July, between 20° and 25° S., North and NW. winds and calms are frequent.

The winds close to the coast are more variable; they are particularly so from Cobija to Callao; north of Callao they are steadier. A land breeze, varying from SE. to ESE., begins ordinarily an hour or two after sunset and lasts till morning; during the night it is dewy, cool, and damp, but the breeze is never strong. A sea breeze, varying from SE. to SSW., sets in between 10 and 11 a.m., and dies away during the afternoon; it sometimes blows quite stiffly; it is then best to be careful in entering the harbors, on account of the sudden violent squalls which sweep down from the high lands.

Occasionally dead calms, lasting for several hours, occur between the land and sea breezes. In April and August, light puffs of wind from North and NW. sometimes happen; these, however, never last more than five or six hours.

The belt of winds we have just described varies in width, being from 100 to 120 miles broad on the parallel of Arica, and from 30 to 35 miles off Callao.

The coast of Peru is not subject to storms or tempests; thunder and lightning are unknown there; gentle rains are common from July to August; near the coast calms are frequent in the interval between the land and sea breezes. The percentage of chances of calms is shown in the tables, § 1.

From December to May, fogs are very thick and frequent, particularly on the southern part of the coast. They last sometimes from twenty-four to thirty-six hours.

§ 23. **Prevailing winds on the coast of Colombia and in the bay of Panama.**—Between cape Blanco and cape San Francisco, situated about 1° N., SE. and South winds prevail all the year round. They frequently shift from South to SW., particularly during the months of February, March, July, August, October, and November.

Between cape San Francisco and Guascama point, situated 24 miles to the southward of the island of Gorgona, the winds, though quite variable, generally blow from SW. and West. In January, February, and March alone northerly winds become rather frequent. Generally the SE. winds haul to the South and SW. on going up the coast from cape Blanco and the bay of Guayaquil; and on passing cape San Francisco they shift still farther to the westward. This belt of winds extends seaward for 100 or 200 miles. Farther from land they gradually shift to South and SE.

Between Guascama point and cape Corrientes the breezes are very baffling; sometimes they come from SW.; in January, February, and March they are often from North to NE. Calms are frequent, and rains persistent during the greater part of the year, especially during June, July, and August, when it rains in torrents. During these months, and even until November, violent squalls occur.

Between cape Corrientes and Panama the prevalent winds are from NW., with squalls. Southwesterly winds and damp weather are frequent between June and December.

Gulf of Panama.—In the gulf of Panama the fine or dry season does not actually commence until December, and lasts till April. During this period the winds are regular and prevail from ENE.; near the coast, however, land and sea breezes exist. The land breeze varies from North to NNE., the sea breeze coming from SSW. At this season the winds in the southern part of the gulf are often very fresh; and, abreast of the coast of Veragua, vessels are frequently obliged to take two reefs in their topsails. In April and May the weather is variable and squally; the NE. winds begin to be interrupted by calms and southerly or southwesterly breezes, which bring rain. The rainy season commences in June, with strong settled winds from South to SSW., interrupted at times with those from NW. There is often much rain in June, July, and August, and sometimes in September. The month of October is damp, but in November the weather begins to improve, the wind setting in again from East to North.

We shall complete these instructions on the system of winds in the bay of Panama by quoting verbatim Maury's observations (editions 1859):

"In the discussion of the winds as it is conducted for the pilot charts, Panama and its approaches are included between the parallels of 5° and 10° N. Between these parallels, and east of 85° W., it appears, from the observations which have been discussed, that the prevailing winds in November, December, January, May, June, and July, are between NW. and SW., inclusive; that in December, January, February, and March they prevail about one-fifth of the time from the northward and eastward; that calms are least prevalent in the month of March, the prevailing wind for March being NW., and for June SW., though NW. winds are also frequent in June, and that for other months the observations are too few to give any indication as to the prevailing winds.

"Between the same two parallels, but to the west of 85°, and as far as 95°, the prevailing winds are in December, January, and February NE.; in March and April they are variable, prevailing alternately from NE. and NW. From May to September they prevail from South to SW., inclusive; in October from SE. to SW., inclusive. In November they are inclined to be variable, though from SE. by the way of South to WSW. is the favorite quarter.

"It is, moreover, indicated that to the east of 80° the winds in December, January, and February, prevailing as they do from the northward and westward, are generally favorable for getting to the southward and westward, by steering SSW. or SW.; that in May calms are frequent, and the prevailing points of the wind are decidely WSW.; SW., and SE.; and in June West, WSW., SW., and NW.; but as the favorite point is West, and calms are not so frequent as in May, June appears to be a more propitious month than May for crossing the parallel of 5° N. by a southwardly course from Panama. Between 5° and 10° N. for the other months, I have not observations enough to the east of 80° to justify me in any remarks as to the winds.

"Neither have I observations enough for January, February, or March to the east of 80°, and between 0° and 5° N., to authorize deductions; but for all the other months of the year they are abundant. They show that, to the east of 80°, between the equator and 5° N., the winds are steady between SE. by the south to West, and that calms are most frequent in this part of the ocean during the months of December and April. The points from which the winds most prevail are, in December, SW., in April, SSW. and SW.; in May, June, and July, SW., in August, SSW. and SW., in September, SW., in October and November, from SE. to WSW.

"Between 80° and 85° W., from the equator to 5° N., the prevailing direction of the wind all the year is between SE. and West by the way of south, though from March to August, inclusive, it is most inclined to be variable. In December, March, and April, calms are most frequent.

"Between 85° and 90°, the prevailing quarter for the wind all the year from the equator to 5° N., is between SE. and SW. It is most variable from January to June, inclusive. In March and June the NE. trades are frequently found here; calms are most prevalent in March.

"Continuing west between the same parallels, the region from 90° to 95° W. seems to be of all, the most liable to calms the year round. From October to January, inclusive, they are not so frequent as in the other months, being less frequent in October. From SE. to SSW. is the ruling quadrant for the winds here all the year; though from January to June, inclusive, they go from NE. around by the way of East to West.

" To the west of 95° they are steady between SE. and South, except from January to May, inclusive. In January, February, and March, they often get as far north as NE., and in April and May as far as ENE."

§ 24. **Prevailing winds on the coasts of Guatemala, Mexico, and California.**—From the gulf of Panama to cape Blanco (gulf of Nicoya, about 10° N.) the winds are variable, but prevailing between SW. and NE., passing around by the way of South and East in January, February, and March. The two principal directions are South and SE., the winds are, as a rule, steady the rest of the year; they prevail from SW. to SE., particularly from the southward.

Cape Blanco to cape Corrientes.—The prevailing winds in January, February, and March are, first, those from NE., varying from North to NW., between cape Blanco and Acapulco; second, those from NW,. varying to North and NE., between Acapulco and cape Corrientes. The first three months of the year correspond to the dry season; at this time the winds often blow violently from NNE. to NE. In April, May, and June, calms are continuous, and the breezes light and variable. From cape Blanco to Acapulco the wind prevails from South to East, and from Acapulco to cape Corrientes from NE. to North and NW. July, August, and September are the bad season, which actually lasts from May to October. SE. and East winds prevail as far as 15° N. Near Acapulco, and continuing as far as cape Corrientes, variable winds blow, principally from NW., but also often from SW. and South, and particularly from SE., ESE., and East. At this season the winds from SSW. to SSE. bring heavy rains and tornadoes, followed by calms all along the coast. Frequently the SW. winds are violent; sometimes the heavy squalls from this direction at Acapulco, San Blas, etc., render it dangerous for vessels to come to anchor or remain any length of time until December.

In October, November, and December prevailing winds are found from NE., North, and NW. to the northward of cape Blanco; these often haul to the westward between the gulf of Tehuantepec and Acapulco; afterward, between Acapulco and cape Corrientes the prevalent winds are found to be from NE., North, and especially NW. The fine season can be considered as commencing in December.

Between cape Corrientes and cape Mendocino moderate weather may be counted upon. The winds generally prevail from NW. The southwesterly winds bring rain, especially in November. In January, February, and March the prevalent winds are from North to NW. and West, with a few southerly breezes between capes Corrientes and San Lucas. From cape San Lucas to about 30° N. they vary from NE. to North and from NW. to SW., the greater part coming from NW. and North. Farther to the northward, from the parallel of 30° to cape Mendocino, variable breezes from all points of the compass may be encountered, especially from NW., North, and NE. Between Corrientes and San Lucas the winds in April, May, and June are from NW., varying to West and SW.; from San Lucas to 30° N. from NW. varying to NNW. and North, while from 30° N. to cape Mendocino they still blow from NW., though varying to North and NNE. In July, August, and September the winds between Corrientes and San Lucas are from NW., shifting very often to West and SW.; from San Lucas to 30° N. they also prevail from NW., varying to North and NE. Finally, from 30° N. to Mendocino, they come from NNW., frequently passing to North and NNE. In October, November, and December the prevalent winds are from NW., varying to NNW. and North between Corrientes and San Lucas, and also extending to 30° N.

Beyond this parallel they are dominant from NNW., North and NE.; but during this season they often blow from some point between WNW. and SSW., in which case they are accompanied by rain. During the whole year thick fogs are frequent, to the northward of 30° N., extending to the 45th parallel. They constitute the principal danger to navigation, and to making a land fall on the coast of California.

North of cape Mendocino.—The winds are variable and present a certain analogy to those which prevail off the coasts of England and Ireland. They are, however, prevalent from NNW. from cape Mendocino to about 50° N., except in December, January, February, and March, when they blow oftenest from SE. to SW. During the winter season the weather is bad, with rain and strong winds which are especially to be feared when they back from WSW. toward the SW., South and SE. Winds from WNW. and North are dry; those from SW. and SE., foggy and damp. The strongest squalls seem to come from between SW. and SE. During all the year fogs are to be expected as far to the northward as 45° N.; they are less frequent in winter than during the rest of the year. alas

Gales of wind are frequent on the California coast during the winter months. They commence in the SE., blowing a fierce gale which lasts from twelve hours to three days with rain; it then works into SW. and blows in very strong squalls with heavy sea for about a third of the time it has been in the SE., then jumps into the NW. and clears with rising barometer. These gales begin as early as October and in January and February follow each other with only a few days interval.

So soon as Bar. makes the slightest rise in the gale from SE to S. we reckon the worst is past.

§ 25. **Revolving storms.**—*Localities—Where it may be expected to find them—Law of storms and rules to avoid dangerous parts.*—These revolving storms are generally known by local names, as hurricanes, cyclones, and typhoons.

Ladrones

In the vicinity of the Marianas and Carolines, hurricanes are common. These extend, *but rarely* as far east as the Hawaiian group and American coast. Cyclones have been known in the northern Pacific and off the coast of Mexico, these are, however, infrequent.

All the above follow the law of revolving storms in the northern hemisphere.

Cyclones in the southern hemisphere.—In the southern hemisphere it is certain that cyclones occur from Australia to the Paumotus, and even farther to the eastward, particularly between the equator and 25° S. These are especially severe about Fiji, Tonga, and Samoa. Through the channels between the Loyalty and New Caledonia islands and the main land, they are much more frequent, two or three occurring in a year. Finally in New Zealand, and in the space between Van Diemens Land and cape Horn, gales, with all the appearances of circular storms, have been encountered. These all follow the law for the southern hemisphere. They commence to the northward, sweep to the West and SW., then South and finally to the SE.

Typhoons of the China sea.—These revolving storms seem to start in the western part of the Pacific, pass in through the islands toward the main land. They are common in the northern part of the China sea above 12° N., on the coast of Luzon; between that and Formosa in the Meiaco Sima, Lu Chu, and Chusan groups and on the South and SE. coasts of Japan. They rarely enter the Formosa channel; as a general rule they travel west, then curve to the northward, NE., and pass out south of Japan; there are noted instances, however, of a sharp recurve below 25° N. and an exit to the eastward. Others driven by pressure from off shore have passed across many miles inland to the westward of Shanghai and over Nagasaki into the Japan sea. August and September are the worst months, but from June to December it is well to be cautious. The fall of the barometer is the surest sign of their approach.

Great care is to be taken whenever any of the following signs are observed between the beginning of June and the first of December: The horizon clear in some points, the tops of the mountains and islands enveloped in heavy black clouds; on the NE. horizon a low, thick, black cloud of a coppery tinge, growing whiter toward the top. In this last case, when the cloud comes up rapidly, the typhoon bursts with rain, thunder, and lightning. The hurricane generally lasts for about twelve hours; afterward it falls calm for about an hour; the wind then shifts to SW., and blows as violently as before.

The diameter of the typhoons of the China seas varies from 60 to 200 miles, and their axial rotation is the same as that of the cyclones of the northern hemisphere, viz: against the hands of a watch, or ↺. Consequently the bearing of the storm center is eight points, approximately, to the right of the wind, your face being to it.

Revolving storms in the southern and northern hemispheres.—December is the first of the months that constitute the hurricane season in the south Pacific and south Indian oceans, and every navigator in these regions should be on the watch for the earliest indications of an approaching cyclone, lest it may be of hurricane violence.

In the outset it should, of course, be understood that no two hurricanes are exactly alike, and a master of a vessel can only be guided by what is known from the experience of others, his own experience, and the indications that he can obtain from the weather, wind, barometer, cloud movements, etc.

The old storm card and the old 8-point rule can no longer be recommended except, perhaps, as a rough-and-ready rule for those who will not take advantage of the progress that has been made since this old rule was established. The bearing of the center will hardly ever be exactly eight points to the left of the wind, but is generally considerably more than that, especially in rear of the storm.

It must also be remembered that the storm is never exactly circular, and that its shape changes as it moves along its track.

Hurricane regions.—The tropics in the vicinity of and to southward of the 10th parallel, the Coral sea, the Arafura sea, and broad belts stretching to southeastward from the vicinity of New Caledonia and of Mauritius toward New Zealand and the island of St. Paul.

Earliest indications.—Barometer above the normal, and continuing so quite noticeably for several days, with dry, fresh, fair weather, and uncommonly transparent atmosphere. The formation, in increasing quantities, of light, feathery, cirrus clouds, and the setting in of a long, low, ocean swell from the direction of the distant storm. The long lines or filaments of cirrus clouds, also, often indicate the bearing of the storm center while it is still hundreds of miles away, as they radiate from it on every side. As the cirrus veil gradually thickens, halos begin to appear about the sun and moon, and the ocean swell increases.

Unmistakable signs.—As the sky becomes overcast with a light veil of cirrus clouds with halos and rings about the sun and moon, the barometer begins to fall, slowly but steadily. The atmosphere loses its pleasant freshness and seems very heavy, hot, and moist. Dark red and violet tints are seen at the rising and setting of the sun, deepening in intensity day by day. Soon the cloud bank of the storm appears on the horizon like a distant mountain range, the barometer falls more rapidly, the wind freshens, and the first nimbus and cumulus clouds appear, with light squalls and passing showers.

Cyclonic circulation.—One of the most important indications that an approaching storm is of hurricane violence is the marked cyclonic circulation of the wind, upper and lower clouds, etc. This may be easily appreciated by remembering that a cyclone of any great intensity is an ascending spiral whirl, with a rotary motion (in the southern hemisphere) with the hands of a watch. (See the diagrams.) The surface wind, therefore, blows spirally inward (not circular except very near the center); the next upper current, carrying the low scud and rain clouds, in almost an exact circle about the center; the next higher current (the high cumulus), in an inward spiral—and so on, up to the highest cirrus clouds which radiate directly outward. The angle of divergence between the successive currents is almost exactly two points of the compass. Ordinarily, with a surface wind from South, for instance, the low clouds come from South also; on the edge of a hurricane, however, when the wind is South the low clouds come from SSE. (two points to the left of the wind), *invariably*. In rear of a hurricane, the wind blows still more nearly inward; with a NW. wind, for instance, the center will be nearly South, the low clouds coming from WNW., etc. Great activity in the movements of the upper clouds, while the storm is still distant, indicates that the hurricane is of great violence. If the cirrus plumes that radiate from the distant storm are faint and opalescent in tint, fading gradually behind a slowly thickening veil or haze, the approaching storm is an old one, of large area; if of snowy whiteness, projected against a clear blue sky, it is a young cyclone of small area but great intensity.

General size and velocity of progression.—The diameter of the area covered by such a storm system, including the outer region where the barometer is above the normal, may be as great as 1,000 miles; the true storm area, however, is very much smaller, especially in the tropics, the diameter of the cloud ring averaging only about 500 miles, and that of the region where the wind is blowing a gale, only about 300 miles or less. In the southern Indian ocean, Mr. Thom thinks that hurricanes when first discovered are from 400 to 600 miles in diameter; the researches of Piddington and of Colonel Reid show that they may be as small as 150 and as great as 600 miles in diameter.

The forward movement of the entire storm seems to vary according to the latitude and to whether the storm be recurving or proceeding on a straight course; in the north Atlantic, concerning the hurricanes of which this Office is in possession of the greatest amount of reliable data, the westward movement of the entire storm averages, in low latitudes, about 17 miles an hour; between the 25th and 35th parallels, where the storm track is curving to the northward and eastward, its velocity is considerably less; and as the storm moves off to the northeastward, its velocity increases to 20 and even to 30 miles an hour. In the southern Indian ocean, Mr. Thom considers that the rates of traveling may be from 10 to about 2 miles per hour. Piddington's researches show that in the bay of Bengal, cyclones travel at rates from 2 to 39 miles per hour, but this last very high rate has, according to the same authority, occurred in only one instance, and it is thought that from 3 to 15 miles may be taken as the usual rate.

There is, however, such a large amount of variation in the size and velocity of these storms that but little confidence can be placed in such general averages, so far as any practical use is concerned.

Intensified trade-wind belt.—A very important fact, established by Meldrum at Mauritius, may be stated thus: When a hurricane is moving along the equatorial limits of a trade-wind region, there is a belt of intensified trades to windward of its track, and, therefore, not until the barometer has fallen about six-tenths of an inch is it safe to assume that, because the trade-wind increases in force and remains steady in direction, you are on the track of the storm. By attempting too early to cross the storm track, running free as soon as the wind freshens, you are liable to plunge directly into the vortex of the hurricane.

Brief rules for action.—Watch carefully for the earliest indications, recording observations of barometer, thermometers, wind, and weather, for future reference. When the decided fall of the barometer, freshening squalls accompanied by rain, and other unmistakable signs, indicate that the cyclone is close upon you, observe the shifts of wind very carefully in order to determine whether you are to the right or left of the storm track; remember that it is sometimes best to lie-to; when thus observing the shifts of wind; a fast steamer, for instance, may run into the dangerous semicircle of a slow moving cyclone and yet get shifts of wind characteristic of the navigable semicircle. If the gale remains steady in direction as it freshens, with a decided fall of the barometer, it indicates that you are on the track of the advancing storm; square away at all hazards and run with the wind on the port quarter, keeping your compass course as the wind shifts; if obliged to lie-to, do so on the starboard tack. If the wind shifts to the right, you are to the right of the storm track and therefore in the navigable semicircle; bring the wind on the port quarter, note the course and keep it as long as possible; if obliged to lie-to, do so on the starboard tack. If the wind shifts to the left, you are to the left of the storm track, and therefore in the dangerous semicircle; haul by the wind on the port tack and make as much headway as possible; if obliged to lie-to, do so on the port tack. Any attempt to cross the storm track is dangerous, but if you decide that it must be attempted, crowd sail and keep the wind well on the port quarter. In scudding, always keep the wind well on the port quarter, in order to run out of the storm; if obliged to lie-to, always do so on the coming-up tack, so that the wind will shift aft and not take you aback. Should you get into the central calm of a cyclone look out for a terrific squall from a point of the compass almost directly opposite to that from which the wind was blowing when it fell calm.

So long as the barometer continues to fall the center is getting nearer; when it steadies and begins to rise, this marks the nearest point, and here the shifts will be most sudden and violent and the sea highest and most confused. If, when lying-to, the wind begins to shift in a direction opposite to what it did at first, it is evident that the storm track is recurving, and that your semicircle is changed; immediate action must be taken to suit the new conditions, but if your vessel is making any great headway it may give you shifts of wind contrary to what you would have if lying-to; this must be borne in mind.

In extra-tropical regions cool weather is characteristic of the navigable semicircle, owing to the indraft from the southeastward; warm weather, on the contrary, characterizes the dangerous semicircle, where the air is drawn in from northwestward.

After encountering a hurricane in the tropics a southward bound vessel is liable to encounter the same storm again in higher latitudes, after it has recurved. The navigator should therefore remember that there is a hurricane off to the westward of him and look out for it as he goes south.

There are two cyclone currents to be considered: a current moving in a circular direction around the center, caused by the wind, and a current which follows the storm along its track. These vary considerably in different storms, but should always be taken into account when near the coast.

The following diagrams, which, it should be understood, are based upon the general or average character of hurricanes, are intended for practical use on board ship:

Diagram A.—Illustrating the circulation of the wind around and towards the center of low barometer in a tropical cyclone, southern hemisphere. The dangerous winds occur in the inner whirls.

Diagram B.—For practical use in finding a ship's position relative to the center of a tropical hurricane, southern hemisphere, by means of the direction of the wind and the fall of the barometer.

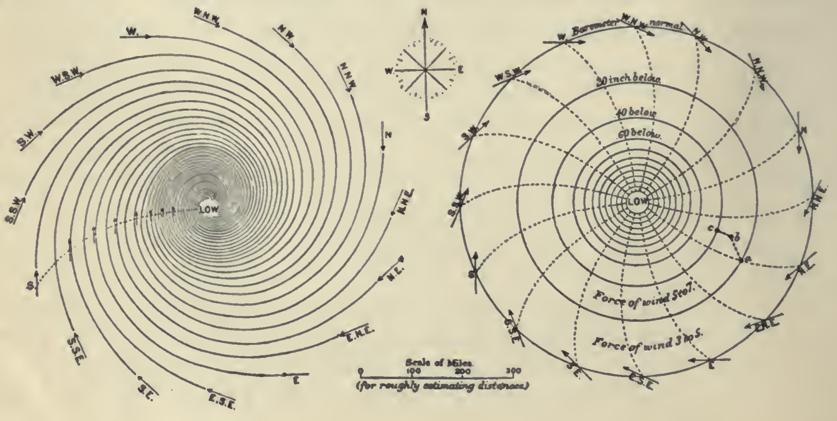

Diagram A.—The spiral lines illustrate the circulation of the wind in a tropical cyclone, southern hemisphere. The diameter of the area represented may vary in different storms and different latitudes from about 100 to about 800 miles, and is generally least in low latitudes. The air is drawn in towards the center of low barometer, gradually takes up a more and more nearly circular path as its velocity increases, and finally whirls around the center with hurricane force. At the center is a calm spot from 10 to 30 miles in diameter; this is marked LOW, and here the lowest barometer reading is obtained. It will be noticed how similar the motion is to that of water in a whirlpool or eddy, and very naturally, as this is nothing but a gigantic whirlpool in the atmosphere, with the suction or draught at the center upward instead of downward.

The direction of the wind at any point on this diagram is the same as the direction of the curve at that point, and the arrows show this direction at the points where they are plotted. By plotting arrows at all points having the same direction, south, for example, and joining them by a dotted line, we find that this dotted line curves toward the center, as shown. The angle of bearing of the center therefore gradually decreases from about ten points at the margin to about eight points in the inner whirls, where the well-known "eight-point rule" becomes true.

Diagram B.—Here the dotted lines are drawn from each wind arrow at the margin to the center, in the way explained above, so that to find the direction of the wind at any point follow out the dotted line to the margin and read it there. The circles are ISOBARS, and the barometer falls $\frac{2}{10}$ of an inch as you go from one of these circles to the next inner one. This illustrates very clearly the rate at which the barometer falls as you approach the center; first slowly, as the broad outer ring is traversed, then more rapidly.

Near the center, where the isobars are very close together, it has been known to fall an inch in 50 miles. Of course, as you recede from the center the barometer rises $\frac{2}{10}$ of an inch as you pass from one isobar to the next outer one, just as it fell on entering the hurricane. This diagram involves as much of our latest knowledge of cyclones as can be used as a general guide, and extends out beyond the regions where the barometer is falling rapidly and the wind and sea have become violent. These diagrams and the accompanying explanations only indicate how you may plot your position on the diagram and obtain from it the probable bearing and distance of the center and the track and velocity of the storm, leaving it to yourself to decide what action to take, having proper regard to the strength and speed of your ship, the lay of the land, and the passage you are making.

Practical use of Diagram B.—Suppose that at 4 p. m., for instance, the wind is NE., and the barometer $\frac{2}{10}$ of an inch below the normal.

Find at the margin of the diagram the wind arrow marked "NE.," and follow the dotted line in toward the center as far as the isobar marked "$\frac{2}{10}$ of an inch below the normal;" this intersection (marked "a") is your position on the diagram; for, by the method of construction just explained, this is the place, and the only place, where the wind is NE. and, at the same time, the barometer $\frac{2}{10}$ of an inch below the normal. Referring to the compass and scale which accompany the diagram, you will find that the center (LOW) bears NW. by W., distance 250 miles. Plot this position of the center on your track chart from the 4 p. m. position of your vessel.

Later in the day, say 8 p. m., suppose that the wind is NE. by N., and the barometer is $\frac{3}{10}$ of an inch below the normal (having fallen $\frac{1}{10}$ during the interval): With this wind your position must be half way between the dotted lines leading in toward the center from the arrows marked "NE." and "NNE.," and with this barometer reading it must be half way between the isobars marked "$\frac{2}{10}$" and "$\frac{4}{10}$" below the normal; it is therefore, at the point marked "b," and the center bears WNW., distance 200 miles. Plot this 8 p. m. position of the cyclone center on your track chart, from the 8 p. m. position of your vessel.

You have thus the position of the cyclone center at 4 p. m. and at 8 p. m. plotted on your chart, and the dotted line joining the two position is the track of the center and the distance it has moved in four hours.

Suppose, again, that at 10 p. m. the wind is still from NE. by N., but the barometer stands at $\frac{4}{10}$ below the normal, having fallen $\frac{1}{10}$ in two hours. Your position is now at the point marked "c" on the diagram, found by exactly the same course of reasoning as before, and the center now bears WNW., distant about 175 miles. Plot this 10 p. m. position of the center on your track chart from the 10 p. m. position of your vessel. If you have been lying-to, this will evidently indicate that the storm's track has recurved, and that you are directly in front of the center. But, no matter whether you have been lying-to or not, your vessel's track and the track and position of the cyclone center are both plotted on your chart, and you can closely watch every change and relative position in order to avoid the center and dangerous semicircle of the hurricane.

§ 26. **Use of the barometer.**—In the instructions for the Atlantic ocean it has been stated that it is indispensable to know, in order to make use of the barometer, the mean barometrical height, or mean level of the mercury at the position of the observer. The data collected for the Pacific are not sufficient to give a table of barometrical heights which would be as reliabe as that given for the Atlantic. But this want of definite and absolute information does not prevent us from taking advantage of barometrical observations in practical navigation.

Thus the mean barometric height in the part of the Pacific where the trades continually blow, varies ordinarily from $29^{\text{in}}.84$ to $29^{\text{in}}.96$. But it is worthy of remark that especially in the western part of the inter-tropical region, the barometer rarely remains steady within the above limits.

Experience shows that decided falls precede or accompany the westerly winds, which sometimes take the place of the trades, during the summer months of each hemisphere. Barometric heights are often observed between $29^{\text{in}}.29$ and $30^{\text{in}}.08$ in both the NE. and SE. trade regions; but bad weather is only to be feared when the fall is rapid.

At 30° N. the mean level appears to be about $29^{\text{in}}.81$; at 35° N. we find it $29^{\text{in}}.69$; at 40° N. only $29^{\text{in}}.57$; and from 40° to 45° N. it is very variable, ranging from $29^{\text{in}}.45$ to $30^{\text{in}}.32$.

In the southern hemisphere we obtain $30^{\text{in}}.00$ at 30° S.; $29^{\text{in}}.88$ at 35° S.; $29^{\text{in}}.73$ at 40° S.; $29^{\text{in}}.65$ at 45° S.; $29^{\text{in}}.57$ at 50° S.; $29^{\text{in}}.53$ at 55° S.; and $29^{\text{in}}.45$ at 57° S.

The mean barometric height at cape Horn is $29^{\text{in}}.25$.

We will now give the principal rules for obtaining the requisite information in regard to the working of the barometer in the Pacific, and will treat of the fall in the barometer which announces the approach of the cyclones and typhoons of the western portion of the inter-tropical zone and the China sea, in a subsequent section.

In the region of general westerly winds the barometer ordinarily announces several hours in advance any important changes in the force or direction of the wind. Gales may nearly always be foretold twelve hours in advance.

In the northern hemisphere, when the wind is about to shift from East to SE. and South, the barometer falls; if the wind passes the SW. point and comes out from West, NW., and North, the barometer rises. When the wind gets to NE. the glass ceases to rise, and begins to fall again with wind from East.

In the southern hemisphere the glass is affected in a similar manner when the wind is about to shift from East to NE. and North, etc., or, in general terms:

The barometer is high, or rises, when the wind is from the adjacent pole; and low, or falls, when it blows from the opposite pole. When the barometric level remains stationary for five or six hours, changes in either the force or direction of the wind need not be apprehended.

If the barometric level oscillates, or, in other words, falls and rises alternately from $\frac{2}{100}$ to $\frac{6}{100}$ of an inch for the space of half a day, the weather will be uncertain.

If it rises gradually from $\frac{4}{100}$ to $\frac{8}{100}$ of an inch in five hours, less wind may be expected or colder and drier weather.

If it falls gradually from $\frac{4}{100}$ to $\frac{8}{100}$ of an inch in five hours, more wind or warmer and damper weather may be looked for.

As a general thing, if the barometric height remains stationary at $\frac{16}{100}$ to $\frac{2}{10}$ or even $\frac{39}{100}$ to $\frac{47}{100}$ of an inch above or below the mean level, the weather will be steady and moderate; from the northward in the first case and from the southward in the second.

The barometer rarely attains the height of $\frac{59}{100}$ to $\frac{78}{100}$ of an inch or more, above or below the mean level, unless during or just before very bad and windy weather.

Nevertheless, the principle that extremes in the barometer denote wind is generally taken too literally.

The following rule is more certain:

It will blow a gale whenever the barometer rises or falls very suddenly; especially when the level reached is distant from the mean level.

It is best, then, in observing the barometer, to note not only if it is above or below the mean level, but particularly to observe the number of inches it has risen or fallen since evening, since morning, or during the three or four hours previous. Thus a moderate movement—say of $\frac{4}{100}$ to $\frac{8}{100}$ of an inch in four hours—indicates moderate winds; while a sudden rise or fall—say of $\frac{16}{100}$ to $\frac{2}{10}$ of an inch in five hours, or $\frac{5}{10}$ to $\frac{8}{10}$ of an inch in twenty-four hours—foretells a gale.

If the wind is from the direction of the elevated pole and the barometer stands very high (at $\frac{6}{10}$ to $\frac{8}{10}$ of an inch or more above the mean level), a sudden fall, accompanied by a rise in the thermometer, shows that the wind will soon come out strong from the direction of the opposite pole.

If, on the contrary, the wind is from the direction of the equator, and the barometer stands very low (at $\frac{6}{10}$ to $\frac{8}{10}$ of an inch below the mean level), a sudden rise foretells a shift of wind toward the adjacent pole.

Cold weather and a sudden fall in the barometer below the mean level indicates snow.

Finally, according as the rise or fall of the barometer is more or less rapid, the weather predicted is more or less close at hand, and will last a longer or shorter time.

Barometer in calm belt and trades.—Speaking of the barometer in the Pacific, Maury says:

"The mean height in the equatorial calms is less than the mean height in the trades on either side. This difference does not probably exceed $\frac{1}{10}$ of an inch. But close attention to the barometer in and about these calms will often enable the navigator to decide whether the winds he may have be really trade winds or not; for, after having been fighting these calms, if you get the wind from NE. or SE., as the case may be, and the barometer rises, then you may be sure that you have the trades. In the calms of Cancer and Capricorn there is a descending instead of an ascending current of air; therefore the barometer ranges higher, on the average, within those two calm belts than it does anywhere else. The difference, however, does not exceed $\frac{1}{10}$ of an inch. Close attention to this instrument will often enable the navigator to decide when he has crossed this belt and got into the region of trades, even before he gets the wind from the trade quarter. He determines this by the fall of the barometer when he enters the trades from the calms of the 'horse latitudes,' but by its rise when he enters the trades from the equatorial calm belt."

Observations of M. le Commandant Proubet on the use of the barometer in the southern hemisphere.—"It may be observed, as applicable to the whole zone, that the direction of the wind has more influence on the barometrical height than even the state of the weather. This influence is much stronger in the variable winds of the southern hemisphere than in those of the northern. It may be also observed that all meteorological phenomena are characterized more strongly in the southern hemisphere. On the parallels of 42° and 43° the barometer, which marked $29^{in}.88$, with squalls from SE., stood steady at $29^{in}.53$, with a gentle breeze from NE., varying to North; and at $29^{in}.21$, with winds from West and fine weather. Several hundredths of an inch fall in the barometer when the wind is from SE. may indicate worse weather than a fall of twice the amount when the wind is from NE., or of three times the amount when it is from NW. This influence that the direction of the wind has over the barometer becomes more and more marked as the latitude increases. So that the standard established for our climates, and which is accurate enough as far south as 41° or 45° S., becomes altogether inexact in higher latitudes.

"It would appear to be almost necessary in these latitudes to graduate a scale for each of the four principal directions of the wind, viz., SE., NE., NW., and SW.; thus a level at $29^{in}.90$, with winds from SE., can be considered as very low, and in no sense gives the idea of variable weather, while $29^{in}.10$, with winds from NW., is a mean level, which answers very well to this kind of weather.

"On the parallels 56° and 57° S., a slow and uniform fall to $28^{in}.35$, with winds from NW. or West causes less anxiety than a level of $29^{in}.50$ on the west coast of France. If sudden oscillations occur, however, there is grave cause for alarm. Everywhere, I think, but principally in these latitudes, movements of this nature foretell bad weather, which is never caused by a slow and regular change. A change of $\frac{2}{100}$ of an inch per hour, might here take place without exciting apprehension; a greater rapidity of movement is invariably succeeded by squalls, and if it attains a rate of $\frac{4}{100}$ of an inch per hour, gusts of great violence are to be expected. There is, therefore, considerable difference in the laws of the barometer according to the latitude; half the above movement, in the neighborhood of 40°, indicated the approach of furious squalls.

"The line of demarcation which it is the practice to draw near the parallel 44° or 45° S., to denote the limit at which our barometers cease to be exact, would appear to be arbitrarily placed. In the south Atlantic, where the first observations on this subject were undoubtedly made, it appears to be quite accurate; but in the middle of the south Pacific, the change in the laws regulating the barometer is not appreciable until we reach 48° or 49° S. In mid ocean, half way between the cape of Good Hope and the southern point of New Zealand, it is, however, very distinctly marked near 42° S. Now, whether this line of demarcation ought to be drawn parallel to the equator or not, it is still admissible to divide the zone into two parts, near the latitudes mentioned above, and this division will allow us to proceed in the following manner with our observations on the law regulating the rise and fall of the barometer.

"In the northern part of the zone of variable winds the barometrical indications are to be interpreted in the same manner as those of the corresponding zone north of the equator; provided, it be remembered that the southerly winds here correspond to the northerly ones of our climate. The easterly and westerly winds have the same respective influence in both hemispheres; the points of comparison in the barometric scale also remain nearly the same; but the variation of the wind has more effect upon the barometer in the southern hemisphere.

"In the southern part of the zone of variable winds the laws governing the movement of the barometer are the same as in the case last mentioned, depending upon the direction of the wind; a rise indicating pleasant weather without a change of wind, or that the wind tends toward SE.; a fall indicating that the wind tends toward NW., or, if it does not change, that the weather will grow worse; but the extent of rise or fall is not at all the same as it is in the other part of the zone, and we would be very apt to be misled if we relied upon a knowledge of the working of the barometer obtained in other localities."

In cyclones and typhoons, the barometer always gives sufficient warning of their approach, and of the distance that the ship is from the center of these storms.

In cyclones the barometric level becomes lower as you near the center. Therefore a vessel is forewarned of the approach of the center if the barometer falls, and of its departure if the barometer rises.

In the tropics, where the accidental variations are relatively small, it is best to be always on the lookout when the barometer is from $\frac{4}{10}$ to $\frac{6}{10}$ of an inch below the mean level, especially when the hourly fall is great. Numerous observations seem to show that, with the barometer at $\frac{8}{10}$ of an inch below its mean level, it generally blows strong enough to take three reefs in the topsails. When the glass stands at an inch or more below the mean level, vessels are compelled to lie-to or run before the wind.

At the storm center the barometer often sinks to $1^{in}.6$ or 2^{in} and even to $2^{in}.4$ below the mean level. In the temperate zones beyond the trades the fall of the barometer should be greater by from $\frac{2}{10}$ to $\frac{4}{10}$ of an inch on the approach of a cyclone. The conclusion is to be drawn from the facts collected by Piddington, that every observer placed in the track of a cyclone will notice the barometer fall from $\frac{2}{100}$ to $\frac{6}{100}$ of an inch per hour, when the distance of the center is from 150 to 250 miles. When the hourly fall of the barometer is from $\frac{6}{100}$ to $\frac{8}{100}$ of an inch, the center is distant 150 or 100 miles; when the hourly fall is from $\frac{8}{100}$ to $\frac{12}{100}$ of an inch, the center is from 100 to 80 miles off; finally, with an hourly fall of from $\frac{12}{100}$ to $\frac{15}{100}$ of an inch, the center is at a distance of not more than 80 or 50 miles.

In certain cases the barometer has been known to fall $\frac{5}{10}$ and even $\frac{75}{100}$ of an inch in an hour.

In general, when the barometer does not fall more than $\frac{8}{100}$ of an inch per hour, a vessel placed in the path of a cyclone may avoid the center. But it becomes nearly impossible to escape it entirely when the hourly fall is more than from $\frac{8}{100}$ of an inch to $\frac{1}{10}$ of an inch.

After the center has passed, the barometer rises as fast as it fell; that is to say, it first rises very rapidly, then slower and slower, as the center recedes.

CHAPTER II.

CURRENTS—ICE.

§ 27. **The Equatorial current.**—The waters of the Pacific ocean show in the tropical regions a tendency to drift toward the west with a variable rate; the mean rate of this movement being about 24 miles per day. This vast stream, about 3,000 miles wide, is called the Equatorial current. It appears to have been particularly observed between the parallels 26° S. and 24° N.

A counter current has been proved to exist, setting to the eastward, at some distance north of the line, and especially in the western part of the Pacific. This counter current, of which a description will be given, § 28, divides the great Equatorial current into two branches, which set to leeward in both the NE. and SE. trade regions, and which are distinguished by the names of the Northern Equatorial current and the Southern Equatorial current.

The Northern Equatorial current begins in the neighborhood of 126° W., and sets toward the West and WSW. with a mean speed of about one knot per hour; it is especially observed between 10° and 24° N., to the eastward of the Hawaiian islands, and between 10° and 19° N., to the westward of this group. South of 10° N. its speed is less, losing itself in the northern limit of the counter current, which is ordinarily felt between 10° and 5° N. The temperature of the water increases from the 24th parallel, where it stands at 74°.5 to the equator, where it reaches about 81°.7 in the eastern portion of the Pacific; 83°.1 in the central part; 88°.5 in the western part, and in the neighborhood of New Guinea. The Northern Equatorial current is felt in the west Pacific as far as the Lu Chu islands (China). It is bounded on the meridian of 142° E. by the parallels 26° and 12° N. Its southern limit passes between Guam island (Mariana group) and the islands of Uluthi, situated about 360 miles to the SW. Beyond the meridian 142° E. the drift is toward WNW., and the bed of the current contracts as it approaches the island of Formosa. At some distance from this island the current inclines to the northward, forming a circuit analogous to that of the Gulf stream in the Atlantic. From this point the stream comes under the head of the Japan current.

Alternate currents, depending upon the prevailing monsoon, exist between the equator and the southern limit of the Northern Equatorial current, and from the meridian of 142° E. to the Waigiu, Gillolo, and Philippine islands. These are sometimes called the currents of the Caroline monsoons, because the maximum speed of this current toward NE. and ENE., is observed a little to the westward of the Caroline islands during the SW. monsoon (from June to October); but during the NE. monsoon (from October to May), the current sets to SW. and WSW., and forms a prolongation of the Northern Equatorial current.

The Southern Equatorial current begins near 88° W., and flows toward West and WNW., with a mean and constant speed of about one knot per hour. In the vicinity of the islands these currents increase in velocity and change direction; in the vicinity of Christmas island, as high as 5 knots per hour have been observed. On approaching any of the islands it is well to carefully watch the drift. This current reaches from the equator to the tropic of Capricon, and even to 26° S, in the part comprised between the Paumotus and Tongas. But the drift of the stream is no longer regular beyond the meridians of the Samoa and Tonga islands; this may be accounted for by the variable winds which prevail from November to March in the western of the south Pacific. Between 20° and 26° S. and west of 178° W. the waters of the Southern Equatorial current divide into two branches called respectively the Rossel current and (§31) the Australian current. (§29). The maximum temperature of the Southern Equatorial current appears to be reached on each meridian between the parallels 8° and 15° S. This maximum is about 78°.8 between 105° and 120° W., 80°.6. between 120° and 135° W., and 84°.2 near 178° W.

§ 28. **The Equatorial Counter current.**—The Equatorial Counter current is an irregular stream setting toward the east; it is about 300 miles wide, and lies between the Northern and Southern Equatorial currents. Though the limits of the counter current are imperfectly defined, it appears to be comprised between the equator and the parallel 8° N.; the greatest width of its bed is never more than five degrees of latitude. In the eastern part of the Pacific it generally keeps between 5° and 8° N., while in the central Pacific it is generally nearer the equator.

It sets toward the east with a speed of sometimes 2½ knots per hour; but its rate is ordinarily much less; the mean speed being about $\frac{6}{10}$ knot.

The existence of a constant easterly counter current in all that part of the Pacific which lies between the Carolines and the coast of America is very doubtful, though at times there is evidence of a set in about the latitude where it should be. But the motion of the sea appears, without doubt, to be constant in the western part of the ocean to the southward of the Carolines, and even as far as the Mulgrave islands. Therefore, sailing vessels can make their "eastings" without much difficulty by keeping a little to the northward of 2° N., which appears to be the limit of the Southern Equatorial current.

Naturally navigation is here rendered still easier between June and October, when the SW. monsoon may be expected. This wind sometimes extends even beyond the Caroline islands. The reader should also remember what was said in § 27 upon the subject of the alternate currents which predominate to the westward of the Carolines, and which certainly sustain the Equatorial Counter current during the SW. monsoon.

§ 29. **The Australian currents (east coast).**—A distinction should be made between the great ocean current and the coast current.

The ocean current off the eastern coast of Australia is only the prolongation of one of the branches of the Southern Equatorial current, which divides a little to the southward of the Fiji islands and west of 178° W. As has been stated in § 27, one branch forms the Rossel current; § 31, the other the Australian current.

This latter current first sets toward the west and passes to the southward of New Caledonia, then it turns to the SW. and passes to the westward of Norfolk island. It continues to run to the SW., setting toward Howe island and to about 28° or 30° S. Here the current is found about 300 miles from the coast, and extends to about 480 miles; that is, its breadth is about 180 miles. It stretches toward the south, particularly between 152° and 157° E., and inclines to the SE. after passing the parallel of the extreme southern limit of Tasmania. The strength of this current varies from 6 to 19 miles per day; its temperature, which decreases rapidly as the waters advance to the southward, has been found to be (in the center of the current) 70° on the parallel of port Jackson; 60°.8 on the parallel of Bass strait; and from 53°.6 to 55°.4 on the parallel of Tasmania.

Currents on the eastern coast of Australia.—On the eastern coast of Australia and to the southward of 28° S., as far as Tasmania, there are two sets of opposite currents, one within 21 miles of the land, the other beyond that distance from the coast.

Thus during the southern summer, from 15th August to 15th April, the current, within 21 miles of the coast, generally sets toward S. by W., with a mean speed of 6 miles per day. At the same time and beyond 21 miles, a current is found setting to N. by E., with a speed of about 18 miles per day.

On the contrary during the southern winter, from 15th April to 15th August, the direction of the current is toward N. by E., with a daily speed of 6 miles, within 21 miles of the coast; while, beyond 21 miles, it runs toward S. by W., with a speed of 18 miles. It should be added that the prevailing current, which exists beyond 21 miles from the coast, from 15th August to 15th April, and which sets toward N. by E., rarely extends beyond 60 miles. Farther from the coast, the ocean current, alluded to at the commencement of the present section, is found.

§ 30. **The Australian currents (south coast, from cape Leeuwin to Bass strait).**—On the southern coast of Australia a tolerably regular current exists, flowing to the eastward. This motion appears to be the natural effect of the permanent winds which blow from NW. to SW., as has been stated in § 6.

Off cape Leeuwin the stream coming from West and SW. appears to be divided into two branches: one striking to the northward, along the western coast of Australia; the other to the eastward, with avariable speed, influenced no doubt by the force and direction of the prevalent winds. In the vicinity of cape Leeuwin and as far as King George sound the rate is often more than a knot, say 28 or 29 miles per day, and even more than 1½ knots, say 36 miles per day, in the part of the ocean comprised between point D'Entrecasteaux and King George sound. Farther to the eastward the speed diminishes, and it is especially variable and feeble in the large gulf lying between the Recherche islands on one side, and capes Northumberland and Bridgewater on the other. Nor does it seem astonishing that, in this large bight, when the wind no longer blows from the westward with any regularity, the current should not set to the eastward with the same strength as between the parallels 38° and 40° S. It would seem only natural that eddies and return westerly currents should be found in the bight and along the land, particularly from January to April, when the winds are here from SE. and ENE.

Beyond cape Bridgewater and in approaching Bass strait the easterly current again becomes manifest with a speed of about one knot per hour.

The body of the current passes to the southward of Tasmania, though a part crosses Bass strait. Therefore a ship is nearly always set to the eastward along the coast of Australia between cape Otway and Wilson promontory. After passing two or three degrees beyond the longitude of the Furneaux islands easterly currents are found; their existence has also often been proved between Wilson promontory and cape Howe, near which they flow to the eastward with a speed of about one knot per hour.

The tides can scarcely be relied upon in Bass strait. In this passage the flood tide sets to the westward, as may be seen by comparing the establishments of the port for different points on the coasts of Australia and Tasmania. Thus, at full and new moon the tide is high successively at cape Howe at 9^h and at Wilson promontory (Refuge creek) at 12^h. Again, at the same epochs, it is high water in the Furneaux islands between 10^h and 11^h; at port Dalrymple at $12^h\ 5^m$, and in Franklin roads (King islands) at 1^h. The ebb tide naturally makes in an opposite direction, or to the eastward, in King strait, and upon the adjacent coast of Australia.

From these observations it will be seen that a vessel making passage through Bass strait from west to east has the flood tide longer than the ebb; this is unfavorable, as the flood tide sets to the westward. Inversely, ships making passage to the westward have the flood in their favor.

§ 31. **The Rossel current.**—As has been stated in § 27, the waters of the Southern Equatorial current, comprised between 20° and 26° S. and to the southward of the Fiji islands, divide into two branches. One of these branches stretches to the SW., increasing the current off the eastern coast of Australia; the other sets toward NW., and is called the Rossel current.

The waters of this current pass between New Caledonia and the New Hebrides, and about 150 miles to the eastward of this group. They flow toward NW. and pass south of Vanikoro island and the Solomon group, when they change their direction to West and WNW., and set toward Torres strait. The speed of the Rossel current varies generally from 4 to 18 miles per day; its mean rate is from 8 to 10 miles. The temperature of the water is about 78°.

§ 32. **General currents in the "Seas of Passage."**—In the "Seas of Passage," that is, in the Java, Celebes, Banda, Timor, and Arafura seas, the currents generally set in the same direction as the monsoons. The water appears to be put in motion by the wind. The currents usually flow in a westerly direction while the NE. and SE. monsoons prevail; on the contrary, their direction is toward the east during the SW. and NW. monsoons.

The direction of the current varies, not only with the change in direction of the wind, which occurs at times during a monsoon; but also, in consequence of the impulse received in the neighborhood of the straits, from the currents which run rapidly in all narrow channels.

The usual speed is rarely over 1½ knots per hour, except through the straits, where it is often much more. Thus, in the straits of Sunda, Bali, Lombok, Allas, Sapi, Flores, Allu, Pantar, and Ombai, the currents are often very rapid; they depend upon the direction of the wind, and especially of the tide. Though they are uncertain and irregular they ordinarily set toward the east in the strait of Sunda from January to April, and in the opposite direction during the rest of the year, with a speed of often 3½ knots per hour.

§ 33. **The great Antarctic drift current.**—This name is given in the Pacific, as well as in the Atlantic and in the Indian oceans, to the great body of water moving toward the east, between 40° and 60° S., with a constancy analogous to that of the prevalent westerly winds.

This current is particularly noticed in the Pacific between 45° and 55° S., from Tasmania and the south point of Stewart island (New Zealand) to about 118° or 108° W. At this longitude a portion branches off and forms the Mentor current, § 34, which flows to the NE., toward St. Ambrose islands, near 78° W. and 26° S. The greater part of the main current continues to drift to the eastward, as far as 84° or 86° W., where the waters of this southern branch divide into two currents between the parallels 42° and 47° S.; one bears to the NE., in the direction of Valdivia and Valparaiso, forming the Chile current (§ 40); the other tends to ESE. and SE., in the direction of the gulf of Peñas and the strait of Magellan, and forms the Cape Horn current (§ 42).

The Antarctic drift current has apparently a mean speed of about 20 miles per day; but the figures on this subject are not thoroughly reliable.

A much stronger current is sometimes noticed setting towards NE. or SE., generally after a series of strong westerly winds. Under other circumstances there is either no current at all, or one in an opposite direction, particularly during the southern summer, and after easterly winds. Generally the current is strongest and most favorable for vessels crossing the Pacific near 50° S.

§ 34. **The Mentor current.**—A part of the Antarctic drift current sets towards ENE., near 118° or 108° W., in the direction of the St. Ambrose islands. This branch, which is called the Mentor current, has a mean speed of $\frac{7}{10}$ knot per hour. It is comprised in a zone of several degrees of latitude, lying to the northward and southward of a line drawn from 42° S. and 128° W., to 30° S. and 85° W. Beyond 85° W. the waters shape their course to the northward; first, toward NE., then toward north, after they reach the parallel of the St. Ambrose islands. Beyond this latitude the current bends rapidly to the NW., passing the parallel 20° S., between 83° and 88° W.; it then bears to the westward and becomes merged in the Southern Equatorial current.

The Mentor current, in the eastern part of the Pacific, unites the Antarctic drift current to the Southern Equatorial current in the same manner as these two currents are united by the Australian current (§ 29) in the western Pacific.

In the northern hemisphere the Equatorial current also describes a complete circuit by uniting the Japan current (§ 37) to the California current (§ 39).

§ 35. **The currents of the China sea.**—The currents of the China sea appear to be caused by the wind; during the NE. monsoon they tend generally to the SW., and during the SW. monsoon to the NE.

This fundamental principle being admitted we shall mention as briefly as possible the principal exceptions, and the most important facts which have been observed and which demand attention.

Current during the NE. monsoon.—During the NE. monsoon the direction of the current on the south coast of China is WSW.; its speed is sometimes 2, 3, and even 4 knots, particularly in shoal water, and within 60 miles of the shore. Between pulo Canton and cape Padaran (Cochin China) the current is southerly, and sometimes reaches, near land, a speed of 2 to 2½ knots. From cape Padaran to pulo Obi it flows to SW., but it should be added that oñ this coast the ebb tide sets to the NE., and the flood to the SW.; from pulo Obi to pulo Capas and pulo Brala there are SSW. and South currents, running at a rate of 2 or 2½ knots per hour. On the northern coast of the Malay peninsula the currents flow to SSE.; between Bintang and Borneo the general direction is southerly.

On the NW. coast of Borneo, and NE. of the Natunas, a counter current often flows to NE. and North. This can be often utilized while beating up the China sea against the monsoon. On the west coasts of Palawan and Luzon the currents are variable, and ordinarily dependent on the prevailing winds; they often set to the northward, especially along the coast of Luzon. When these currents are strong as far as cape Bojeador, they then bend to NE. and ENE. toward the Babuyan islands, where they meet the SW. current coming from the north of the China sea; and also the westerly current coming from the Northern Equatorial current. Consequently eddies and variable currents are here found flowing in different directions, and often obtaining considerable speed.

In Formosa channel the current sets to the southward.

Current during SW. monsoon.—During the SW. monsoon the flow of the current varies on the east coast of China, from NNE. to ENE.; its speed sometimes being 3 or 4 knots. At the Pescadores isles, a current has been noted during the month of August, setting to the northward at the rate of 4 knots. On the southern coast of China the current flows to the eastward. The waters of the Canton river make out to sea in a direction between WSW. and WNW., forming a genuine current with a speed which often reaches one or 2 knots between Macao and St. John. Still it is best not to rely on this current, as it sometimes amounts to little or nothing or is replaced by an easterly one during the SW. monsoon. Between cape Padaran and Hainan the stream is very irregular and feeble, especially along the coast between Padaran and pulo Canton. Abreast of the gulf of Tonquin, and during NW. and West gales, the current flows to SW. and South; and as it sets across the direction of the monsoon, a heavy and broken sea is produced. From Padaran to pulo Obi the current flows toward east, but the tide must be taken into account along this coast, the flood setting to SW. and the ebb to NE. Abreast of the gulf of Siam the currents are to the North or NE.; on the northern coast of the Malay peninsula they flow to the north; on the western coast of Palawan and Luzon a moderate current sometimes flows to the north. Northerly currents sometimes make out from near cape Bojeador with great swiftness and tend to the NE., toward the Calayan and Camiguin islands (Babuyans); one part of the stream follows the north coast of Luzon, flowing ESE.; then meeting cape Engaño, bears to the northward. The waters are then affected by the Northern Equatorial current, which impels them to the NW. They have sometimes a speed of 5 knots per hour, which slackens quickly some distance beyond cape Engaño. The current which we have already noted as existing during the NE. monsoon causes strong eddies among the Babuyan islands, but rarely reaches to the Bashees. In this last group of islands the current flows swiftly in a northerly direction; sometimes it tends toward the east when there are strong westerly breezes.

§ 36. **The currents of the Japan sea.**—The reports of captains who have navigated this sea prove the existence of a current setting north through the straits of Korea and east through the straits of Tsugar and La Perouse. This would indicate a northerly set throughout the Japan sea. It is also probable that there is along the coast of Siberia a narrow cold current which runs southerly, and joining with or dipping under the northerly current, disappears.

§ 37. **The Kuro Siwo or Japan current.**—One branch of the Northern Equatorial current, after having passed the Mariana islands, flows toward the eastern coast of Formosa, in a WNW. direction. It makes a sharp turn toward north while passing between Formosa and the Meiaco Sima islands. Next flowing toward NE. it makes the circuit of the Lu Chu islands; then it passes between the islands of Kakai Sima, and O Sima to the southward; and the large island of Kiusiu to the northward. It bears off along the coast of Niphon, passing by the bay of Yedo, and opens out, in a fan-shaped manner, toward the different points of the compass between NE. and East. After leaving South island and Bayounaise rock, situated nearly on the meridian of the bay of Yedo, the current occupies nearly the whole sector, which extends from 40° N. to Moor island.

This current is called Kuro Siwo by the Japanese; that is, black current, on account of its dark-blue waters, and presents many analogies to the Gulf stream of the Atlantic.

Its breadth, between the islands of Formosa and Meiaco Sima, is hardly 100 miles; but it rapidly grows wider after the current has doubled the Lu Chu islands. Between the Bonin islands and the coast of Niphon it attains a width of about 500 miles.

Its average speed appears to be about 1½ knots. From the strait of Formosa to the coast of Japan it increases, and reaches its maximum between the meridians of Kiusiu and the bay of Yedo.

In this part of the current a speed of from 72 to 80 miles per day is sometimes observed. On the parallel 35° N., and at a distance of 200 miles from the coast, a current setting to ENE. has been proved to exist, with a speed of 48 miles per day; and on the same parallel, at a distance of only 75 miles from the coast, the speed has been found to be 72 miles.

King states that in the same latitudes there is a current of 5 knots per hour. During the winter (November) the currents of the coast of Japan have a more northerly direction; in summer (July) they incline more to the eastward.

The mean maximum temperature of the Kuro Siwo is about 86°. The northern edge of the Kuro Siwo is separated from the coast of Yezo and Niphon (to the north of Yedo bay) by a cold current coming from Kamchatka and the Kuril islands. This cold current is analogous to the one which lies between the Gulf stream and the coast of the United States; its temperature is about sixteen or twenty degrees below that of the Kuro Siwo. The limit of the two currents is marked by the sudden change in the color and temperature of the waters.

As in the Atlantic, eddies, bad weather, and thick fogs are here found. It is not so easy to determine the southern limit of Kuro Siwo. The change of color in the water is nearly imperceptible; the change in temperature cannot be more than seven or nine degrees, and is only gradually felt. Near 146° or 147° E., between Moor island and 40° N. the Kuro Siwo current divides into two parts. One, called the Kamchatka current (§ 38) flows in a NE. direction, having for its axis a line drawn through 151° E. and joining 40° N. with Bering strait. The other branch, which is by far the larger, crosses the Pacific in a general easterly direction, in the same manner as the Antarctic drift current in the southern hemisphere.

This main branch of the Kuro Siwo is generally called the Japan, or Tessan current. The waters of this stream flow toward East and SE., after passing the meridian 152° E., until they reach 172° E., between the tropic of Cancer and 40° N. The current bears toward East between 172° E. 163° W., and particularly in the zone to the westward of the Hawaiian islands, included between 20° and 24° N. On the meridian of 163° W., and north of the tropics, as far as 44° N., the direction of the current is nearly NE.; the southern part of the current is bounded by a line passing through 163° W., and joining the tropic, and 40° N. at 148° W. On this meridian of 148° W. the current flows NE. between 40° and 50° N., it then tends to East and SE., and unites with the current of the coast of California.

The temperature of the current of Tessan has been found to be 81°.5 at 27° N. and 177° E.; only 61° at 36° N. and 128° W. This shows the cooling of the waters during their passage through 55° of longitude. The temperature has been found to be from 77° to 79° at 21° N. and 163° W.; in other words, at this point on the southern limit of the Tessan current the water was at least 3°.5 warmer than in the Northern Equatorial current, which flows in an opposite direction, a short distance farther south.

§ 38. **The Kamchatka and Bering currents.**—The waters of the Kuro Siwo separate into two branches, as has been stated above, near 146° or 147° E., between Moor island and 40° N. The least known, as well as the least important, of these branches takes the name of the Kamchatka current; it flows toward NE., having for axis a line passing through 151° E., and joining 40° N. and Bering strait. This current, about which little is known, passes to the west of the Aleutian islands, at a distance of about 150 miles from the coast of Kamchatka. In August and September the temperature has been found to be 52° off Petropaulski; its speed is about $\frac{3}{10}$ knot per hour.

It may be here stated that there exists a cold polar counter current between the current above mentioned and the coast of Kamchatka. It comes from Bering sea, follows the coast of Kamchatka and the direction of the Kuril islands, and gives rise to currents which cease in the southern part of the sea of Okhotsk.

Bering current is a stream which runs at a rate of about ½ knot, and appears to issue from Bering strait, and bends first toward SSE., afterward passing to the eastward of St. Lawrence island. It then flows South and SSW. toward the Aleutian islands, passing to the eastward of St. Matthew island.

§ 39. **The currents of the coasts of California and Mexico.**—On the coast of California, from about 50° N. to the mouth of the gulf of California, 23° N., a cold current, 200 or 300 miles wide, flows with a mean speed of $\frac{7}{10}$ knot, being generally stronger near the land than at sea.

Usually it follows the trend of the land, that is, nearly SSE., as far as point Concepcion (south of Monterey), when the current begins to bend toward SSW., and then to WSW. off capes San Blas and St. Lucas. The temperature off Monterey is not more than 55°.5 or 57°, and only 59° at 30° N.

From cape Mendocino northward to the north of Vancouver a narrow northerly current close to shore prevails, force about $\frac{6}{10}$ knot per hour.

On the coast of Mexico, from cape Corrientes (20° N.) to cape Blanco (gulf of Nicoya), there are alternate currents extending over a space of more than 300 miles in width, which appear to be produced by the prevailing winds.

During the dry season, January, February, and March, the currents generally set toward SE. During the rainy season, from May to October—especially in July, August, and September—the currents set to NW., particularly from Cocos island and the gulf of Nicoya to the parallel of 15°.

§ 40. **The currents of the bay of Panama.**—After leaving cape San Lorenzo, or the equator, a current is found along the coast of South America, 60 miles in width; it follows the direction of the land, and, entering the bay of Panama, makes a complete circuit of that gulf. After meeting the western coast of the bay of Panama the current turns to the south and acquires considerable velocity, especially during the dry season, from December to April, when the winds are frequent from ENE.

In the bay of Panama, and at its entrance, the currents are far from being regular, and, under certain circumstances, are quite strong. Eddies and a short, chop sea are particularly noticed in the SW. part of the mouth of the gulf. Farther out, near Malpelo island for instance, very rapid currents are found; these have been observed to set in entirely opposite directions, sometimes toward ENE., at others toward SW.

§ 41. **The currents of the coasts of Chile and Peru.**– It has been stated (§ 33) that the Antarctic drift current is separated into two branches, between 42° and 47° S. One of these branches flows toward NE., in the direction of Valdivia and Valparaiso.

This stream follows the various curves of the coasts of Chile and Peru, and forms the important current, the existence of which was first noted by Humboldt.

The principal characteristic of this current is its relatively low temperature.

Abreast of Valparaiso 52° have been noted; of Coquimbo, 57°; of Arica, 64°.5; of Callao, 65°.5; of Truxillo, 69°, and off cape Blanco, 66° to 73°.5. The general direction of the waters between Pisco and Paita is toward NNW. and NW.

Near cape Blanco the current leaves the coast of America and bears toward the Galapagos islands, passing them on both the northern and southern sides. Here it sets toward WNW. and West. The breadth of the bed, on the meridian of the Galapagos, is from 400 to 500 miles; beyond this it widens rapidly, and the current is lost in the Equatorial current near 108° W.

The breadth of the current near the coasts of Chile and Peru and as far as cape Blanco is about 150 miles. Its mean speed is nearly 15 miles. Between Paita and the Galapagos, where it obtains its maximum rate, it has been known to run on rare occasions as fast as 50 miles in a day; but on the coast, from Valparaiso to Callao, the greatest speed appears to be 24 miles per day; sometimes it is only 3 miles in twenty-four hours; nor is it very rare to find currents setting to the southward. These act in the most unforseen manner, but usually last only for a short time.

As often happens in similar cases, the existence of a counter current has been proved on different occasions. This sets toward the South with a maximum speed of ½ knot per hour, is very irregular, and extends only a little distance from shore.

§ 42. **The Cape Horn current.**—In the "Navigation of the south Atlantic ocean," page 131, will be found a description of the Cape Horn current, to which the reader is referred, and which will be here completed.

The waters of the Antarctic drift current (§ 33) divide, between the parallels 42° and 47° S., into two branches, one of which flows ESE. and SE., in the direction of the gulf of Peñas and the strait of Magellan, and forms the Cape Horn current.

The stream follows the indentations of the west coast of Patagonia, though with a general SE. and ESE. direction, being about 150 or 200 miles in width. The current runs around Tierra del Fuego, toward East; then flows to NE., passing through the strait of Le Maire, and by Staten island.

The swiftness of the current is uncertain on account of the great variation of the winds in these quarters. However, the following observations can be considered as forming a reliable average:

On the meridian of 80° W., and between 55° and 60° S., the current flows to SE. and ESE at a rate of from 12 to 24 miles per day. On the meridian of 75° W., and about 120 miles to the southward of cape Pillar, the current flows to SE. at about 12 miles. On the same meridian, between 55° and 60° S., its speed is from 18 to 24 miles in an easterly direction. At 70° and 71° W. and 58° S., its direction is easterly, and rate about 30 miles per day. South of cape Horn, on the meridians of 68° and 69° W., it often attains a speed of 30 miles. To the southward and eastward of the cape the stream begins to curve to the northward and eastward, while between cape Horn and Staten island its speed near land is about 24 miles, toward NE. The regular currents are, however, affected by the tides running through Le Maire strait.

The flood is from east, on the northern coast of Staten island, and from north in Le Maire strait; according to Horsburgh it runs at about 2 knots per hour, and is influenced by the wind; the speed of the ebb is never more than one knot. King and Fitz-Roy state that the flood runs as fast as 5 or 7 knots through Le Maire strait.

Between cape Horn and Staten island the flood flows toward NE. Thus, at the full and change, high water occurs at $3^h\ 50^m$ at cape Horn, and about $4^h\ 30^m$ at Staten island. The flood tide flows toward NE., with a speed of 3 knots or more per hour, between cape Horn and the strait of Le Maire. These currents are scarcely felt south of Staten island.

Therefore, vessels entering the strait of Le Maire with favorable winds can easily pass through during the flood, and afterward take advantage of the ebb tide, which sets to SW. between the strait and cape Horn.

§ 43. **Icebergs and ice.**—In the northern Pacific there is no danger of meeting floating ice below 50° N., but it is not advisable to pass that parallel in making passage between Japan or China and California. In the southern Pacific floating ice has been encountered at all seasons, and often in quite low latitudes. Icebergs are, therefore, always to be feared, especially during the southern winter, as the nights are then long. They constitute a real danger, and the principal difficulty in making a passage from Australia, New Caledonia, New Zealand, or Tahiti, to cape Horn.

Icebergs have been encountered in March and April. They have also been frequently seen from April to August, particularly between 90° and 160° W., and as far north as 41° 45′ S. Finally, icebergs have been found in great numbers, especially between these same meridians, from September to January. There is, however, danger of meeting them at all times of the year.

In the following table will be found the latitude limit of floating ice, on each meridian, for every ten degrees, or even for every five degrees, when the changes are great. Though vessels may run south of this limit without encountering ice, they should always keep a bright lookout while in or near these localities:

Latitude limit of floating ice.

Longitude.	Latitude limits.		Longitude.	Latitude limits.		Longitude.	Latitude limits.		Longitude.	Latitude limits.	
°	°	′	°	°	′	°	°	′	°	°	′
60 W.	53	15	110 W.	42	45	170 W.	40	10	150 E.	51	30
65 W.	56	30	120 W.	42	20	175 W.	45	50	140 E.	47	15
70 W.	57	15	130 W.	41	45	180 W.	49	30	130 E.	45	20
75 W.	57	00	140 W.	41	20	170 E.	51	15	120 E.	45	00
80 W.	55	10	150 W.	40	45	160 E.	53	00	110 E.	45	00
90 W.	47	00	160 W.	40	30	155 E.	52	45	100 E.	44	40
100 W.	44	00									

A few general principles will now be given which should govern the navigator of the south Pacific. For information on this subject we are indebted to Messrs. Towson, Weddel, Boulton, Scoresby, etc.

From the 1st April to 1st October floating ice is hardly ever found to the northward of 50° S., and is rarely met even as far south as 50° or 53° S., except between 148° and 93° W. During this season it may be expected between 53° and 60° S., from 158° W. to cape Horn.

From the 1st October to 1st April, icebergs are more numerous, stray bergs sometimes drifting as far to the north as 40° S., though they are rarely observed to the northward of 50° S. But navigators should be very vigilant after passing 50°, as there is very little space between 50° and 60° where icebergs have not been observed. They are particularly abundant beyond 52° S., and from the meridian of 173° W. to that of 88° W. Many are also found to the eastward of 70° W., and to the southward and eastward of cape Horn.

The direction and rate of their drift.—The icebergs of the Pacific generally drift toward E. by N., with a speed of 10 miles per day. But to the eastward of cape Horn they drift first to NE., then change their direction more to the eastward in approaching 40° S. On this parallel, and between 25° and 15° W., they set toward east rarely advancing more than one mile per day. Then they bear away toward ESE. and SE.

Between the cape of Good Hope and Australia it is impossible to state the parallel on which icebergs may not be encountered by a vessel making passage to the eastward; one year icebergs are found on one parallel, the next on another.

If, however, the parallel 52° S. is passed, the chances of meeting icebergs are undoubtedly increased. It is therefore best to keep to the northward of 51° S.

Between 70° and 80° W.—Icebergs appear to be more numerous between 70° and 80° W. and 56° and 58° S. than farther to the southward. This statement does not, however, hold true for the region east of 70° W.

Signs indicating their approach.—The following signs indicate the approach of an iceberg: A peculiar light, known as "ice blink," which is sometimes seen at a great distance, even on a dark night. On coming close to the iceberg, this light has the effect of a white cloud settling over the rigging. The most certain indication is the falling temperature of the water, and its comparison with that of the air. It is therefore important to make frequent observations of the temperature of the water. This fall often amounts to 3°.5 and even 5°.5.

This proximity of icebergs is also known by the noise of the waves breaking over them; this is sometimes heard a great distance, and resembles breakers on the shore.

With fair winds it is best to pass to windward of large icebergs, for then there is less danger of encountering the detached masses of ice, which always drift faster to leeward. These small icebergs are the most dangerous; they are often very deeply submerged; hardly show above the water, and cannot be seen when the sea is rough.

Ice blinks when seen.—The "ice blink" of which we have spoken is, as a rule, observed only above large masses of ice, which are more or less flat and covered with snow. But this luminous appearance does not show above icebergs whose surfaces present a rugged appearance, or above those which have been capsized.

Good lookout necessary.—It cannot be too often repeated that watchfulness is necessary. The man on lookout should be often relieved. He should keep his eye continually on the black line of the horizon ahead, and if he discover a white spot or even a light streak on the horizon, he may know it is ice. If a good watch be kept in this manner there is no danger of coming upon ice unexpectedly. It is also well to have another man on the watch for small icebergs, which are only to be seen at short distances.

Numerous during the southern summer.—As has been said above, icebergs are most numerous during the southern summer. This is fortunate, as the nights are then shorter. Out of 550 icebergs, nearly half were seen in November, December, and January, while there were only five found in June and three in July. One-fifth of the whole number of icebergs seen in a year were observed in December alone. There are more from January to April than from August to November; thus the number in March and April is to the number in September and October as five to three.

Warnings.—According to Scoresby, the fall in temperature of the sea and air foretells icebergs, but it is extremely imprudent to trust to this warning. It is best to rely chiefly on the vigilance of those whose duty it is to keep a "sharp lookout." Have your yards nicely trimmed, and be ready at any moment to go about or haul up on either tack, as may be necessary. The reader should also refer to § 104, where further information on this subject will be found.

Ice in harbors and along the coast.—Ports in the north of the Gulf of Pechili and along the eastern coast of Asia above Korea are liable to be frozen up after November 1st. Vessels should, after the 15th of October, watch carefully the temperature and be ready to leave at the first forming of ice.

*Ice and ice movements in Bering sea and the Arctic basin.**—*General description of the ice in different localities.*—The "Arctic pack," which never melts, consists of hard, blue ice, made up of fields of comparatively level ice, as much as 4 miles in diameter, which are surrounded and interspersed with hummocks from 20 to 40 feet high. Along the edge of the pack "leads" are found running into it for short distances in different directions; when the pack moves it goes in a body, and these leads are continually changing, opening and closing, so as to make it impossible for a vessel, once caught in the pack, to proceed at will. A vessel so caught is unmanageable, even should she escape being crushed, and all the whaling captains agree that, if it is found impossible to get out before young ice makes, nothing can be done except to abandon her.

In the spring, with the prevailing southerly winds and northerly currents, the pack breaks off from the shore ice and moves north, the northern limit of its southern edge varying in latitude, as will be shown further on, and is held north until the fall, when it again moves south. During these summer months ice melts, evaporates, and disappears, so that, when the pack returns south, the old ice probably does not come below the latitude of Icy cape in a body, unless it does so well off shore.

I can find no record of the old pack being seen from the shore in the fall below Icy cape, such portions of the old ice that are found below that latitude being composed of detached and much broken floes.

The shore ice and flow ice is that which remains fast to the shore after the pack moves off, and which gradually breaks off and follows the pack in floes and floebergs. It becomes scattered and is quickly affected by varying winds and currents, and vessels fitted for ice work, can work through it quite readily, so long as young ice is not forming.

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*By Ensign Edward Simpson, U. S. N., U. S. S. Thetis—Lieut. Commander, Chas. H. Stockton, U. S. N., Commanding.

When a vessel has worked into floe ice until it becomes too heavy for her to proceed, she ties up to the ice and awaits a shift of wind. It is surprising how quickly a shift of wind will change the appearance of ice in a few hours, making wide leads where shortly before the ice was heavily massed. When young ice is making, it forms very rapidly between the cakes of floe ice, joining all in a solid mass, and locking a vessel, so caught, very quickly.

Large, hummocky floes, which drift or are forced up into shoal water, and become grounded, are known as "ground ice," and it is to these that vessels secure to seek shelter in gales from fast drifting floe ice or during temporary settings in of the pack. These pieces of ground ice are recognizable, when there is a current running, by the wake they leave, or by the height of the "overhang" of their former water line above the surface of the water.

Vessels forcing their way through floe ice always avoid striking ground ice on account of the great risk of being "stove" on it, and also the impossibility to move it. One whaling captain describes making fast inshore of a floe of ground ice, showing only a few feet above the water, which was forced inshore by the pack until it was as high as his foreyard.

"Young ice" is the name given to new ice just forming. During cold weather, when the wind is light or calm, young ice forms very rapidly. In the vicinity of the pack, with northerly winds in early October, it can be seen shooting off in forks from the edge of the pack so rapidly that vessels keeping along its outer edge are out of sight of the pack in a few hours. When not in the vicinity of the pack, young ice forms in spots, which spread out like oil upon the water and soon join in a solid sheet. It forms first from the pack and floe ice, and then from the shore, and spreads out until the whole ocean is covered in a few days. During a cold, calm night it forms to a thickness of from one to six inches. The best of the whaling steamers that go into the Arctic can probably steam at the rate of 9 knots in open water, but can barely force their way through young ice of five inches in thickness at 3 knots an hour.

The ice in Bering sea, although it is made up entirely of young ice every year, may be divided into two kinds, viz: that which forms in the late fall and early winter, and is telescoped and piled into heavy masses during the shifting gales; and, secondly, that which forms in the late winter and early spring in the spaces left by the old ice moving. This solid ice probably does not extend to the southward of St. Matthew island, while the ice below it as far as the southern limit is made up of the newer ice and detached floes of well-broken ice.

All the ice seen in the vicinity of the Pribilof islands is broken floe ice that is influenced continually by the wind and tides. Vessels forcing their way north in the spring enter this new ice readily, if it is well broken, steamers forcing through it and ramming when necessary; and sailing vessels, when they have a fair wind, lashing their helms and letting the ship find her own way through it under easy sail. The heavy winter ice is always avoided, and the newer, ice, when in large floes, is also very dangerous on account of their weight being sufficient to sink a ship should they come together.

A case of this occurred May 25, 1885, when the ship *Gazelle* tried to run out a gale between two ice floes and was crushed and sunk. Or a ship may be detained in this ice, as in the case of the steamer *Belvidere*, which was nipped and drifted forty-three days in the ice in the western part of Bering sea.

The heaviest patches of ice in Bering sea are met in the spring by vessels off cape Navarin or north of St. Lawrence island; and it is the ice that forms in the gulf of Anadir, where the strong NE. gales drive against the current and keep piling, grinding, and telescoping the ice into heavy masses.

Southern limit of the ice.—Although there is a tradition existing in Unalaska that one winter, years ago, the ice came down on the island in heavy masses; and in January, 1878, it was down on Akutan island and in Unimak pass, when several native boats were lost in it, the southern limit can safely be said to be in latitude 56° N. about 35 miles south of St. George island. Occasionally, as in 1886, no ice is seen at the Pribilof islands, but generally after three weeks of northeasterly winds it comes down from the mouth of the Kuskokwim river in very much broken floes, and remains in sight, moving to the eastward and westward with the winds, until the spring, when a southerly wind soon drives it north. This generally occurs in the latter part of April, although in 1880 it remained so late that an iron steamer, the Alaska Commercial Company's steamer *St. Paul*, unfitted for encountering ice, was unable to effect a landing until June 1.

Whaling vessels, which are sheathed and fitted for ice work, take the ice about April 7–15, although a few do so as early as March 25. Those entering Bering sea by Unimak pass meet the ice in the latitude of St. George island, while those coming through Amukta pass meet it in longitude 175° W., latitude 58° N. In longitude 180° it is found in latitude 60° N. about April 15. The most southern point I have found vessels reporting ice is latitude 56° 10′ N., longitude 171° 30′ W., on April 12, 1889; and several report meeting it in latitude 57° 30′ N., in about longitude 175° W., during the middle of April. The general contour of the southern limit of the ice in Bering sea is from Bristol bay to about 35 miles south of the Pribilof islands, and then NW. in the direction of cape Omchinsky.

Spring movements of the ice in Bering sea.—The movements of the ice upon breaking up in the spring are due altogether to the currents and winds; and, as the currents are greatly affected by the prevailing winds, navigators wishing to push north early should be influenced in their movements largely by them. While the pack remains solid in the middle of the sea, both sides are found navigable much earlier. This is due to the breaking up of the ice off shore by local winds, the northerly currents, and the currents setting out of the numerous rivers. Whether the east or west shore is the more open depends largely upon what the prevailing spring winds have been, strong easterly and northeasterly winds packing the ice heavily on cape Navarin and breaking it up on the east shore, and vice versa. On the west shore the current sets NE. well off shore, and although its speed is increased or diminished by prevailing winds, it is seldom that the current changes its direction to the southward. In 1886, the bark *Sea Breeze*, during a NE. gale off cape Navarin, furled all sail, made fast to a floe of drifting ice, and in three days drifted 45 miles to windward. Off cape Navarin the current splits about 30 miles off shore, one branch following the trend of the coast in a southwesterly direction toward cape Omchinsky, and the other running to the northward into the gulf of Anadir and then off to the NE., running strong between St. Lawrence island and Indian point.

In May, 1889, the bark *Abraham Barker*, when about 30 miles SE. of cape Navarin, encountered a NE. gale and drifted in well towards cape Omchinsky in the SW. current.

In the spring of 1887, the bark *Hunter* was nipped in the middle of the gulf of Anadir and drifted with the ice out of the gulf and to the northward of St. Lawrence island, passing very close to cape Chibukak.

On the east side of Bering sea, between St. Matthew and Nunivak islands, the set of the current is North. With prevailing NE. winds it sets NW., and with NW. and SW. winds, NE. This northerly current continues past the east side of St. Lawrence island to Kings island; from there it sets in toward port Clarence, then follows the trend of the coast past capes York and Prince of Wales, and into the Arctic ocean. The current on the east side is not as strong as that on the west side, and north of St. Lawrence island the west shore from Indian point to the Diomede islands is invariably clear of ice before the east shore; consequently Indian point is the first objective point for vessels pushing their way north in the spring. The action of these currents is as follows:

Ice clears the Pribilof islands about May 1. The pack moves north, the sides clearing ahead of the center, and vessels following the pack reach cape Navarin about May 10. Here the heavy ice, which forms in the gulf of Anadir by the young ice piling up under the influence of NE. winds, is met coming out of the gulf. This ice is set to the eastward by the spring southerly and westerly winds until it meets the strong NE. current, when it sets up into the channel between Indian point and St. Lawrence island; then the main body of it swings around on the north and NE. side of St. Lawrence island, where it lodges until the last of it breaks up and goes north during the middle of July. Young ice continues to form in Bering sea until May 10, and after that time it is not looked for. On April 12, 1888, the steamer *Orca* steamed for six hours through young ice in about latitude 60° N., longitude 178° E. It sometimes happens that vessels find a clear lead from cape Navarin to Indian point or St. Lawrence island as early as May 18, but this occurs only in exceptional seasons. As a rule vessels that are determined to keep the west shore follow leads into the gulf of Anadir, steamers forcing through the broken ice, and sailing vessels hauling through it with ice hooks and steam winches; the former coming out into clear water off cape Bering about May 25, and the latter about June 10. When cape Bering is clear, Indian point can be reached without much difficulty. Should a vessel arriving near cape Navarin find the ice heavily packed in that vicinity, indicating prevailing easterly spring winds, she should not be misled by the space of open water that generally exists south of the cape, and which is about 50 by 25 miles in extent, but should follow the line of the pack to the eastward and try the eastern shore. By so doing she will probably find the edge of the pack in the longitude of St. Matthew island, in latitude 59° to 60°; from there it will lead her close to the west coast of Nunivak island, from which position she should work up to the SE. cape of St. Lawrence island; thence she may work along the south side of the island and find clear water from cape Chibukak to Indian point before the ice is open from cape Navarin to cape Bering. It is useless to attempt to pass to the northward of St. Lawrence island from the east side, as the heavy impassable ice, before mentioned as coming out of the gulf of Anadir, exists there much later than it does on the southern shore.

This eastern route is frequently undertaken by the whalemen; indeed, some of them always take it in preference to attempting the western route, in order to reach open water off Indian point and meet the whales coming "head on" through the heavy ice to the southward. It is a mooted question by which route a vessel can get north at the earliest date; but I should recommend giving the preference to the west shore, and if that is found heavily blocked, then to lose no time in trying to force the ice, but follow the southern edge of the pack and attempt the eastern route, which will probably be found in that case comparatively open.

North of St. Lawrence island the west side of Bering sea clears of ice much earlier than the east side, and vessels reaching Indian point find the ice broken into large floes around which they can work outside of the shore ice as far as East cape. The bay and shore ice break up at a much later date.

As seasons vary to a great extent, due to the prevailing winds, it is difficult to fix dates for the probable arrival of vessels at different places; but, as a general rule, steamers reach Indian point about May 25 to June 5, and St. Lawrence bay about June 10–25.

In 1882 the *Corwin*, after protracted westerly gales, reached St. Lawrence bay May 11, remained there a few hours and then returned south. Shortly after leaving an easterly wind set the pack on again and closed the bay for six weeks. This shows that vessels which succeed in getting so far north at such an early date only accomplish it under peculiarly favorable circumstances and, even then, at great risk, as the pack is not sufficiently broken up until the middle of June, in that vicinity, to enable vessels to proceed fearlessly.

The prevailing winds north of St. Lawrence island are southerly after April 15, and the pack breaks off at that time about 6 or 8 miles off shore. It comes in and moves off with the varying winds until June 15, when it breaks up and goes off to the northward.

The natives put their canoes in the water about May 15, showing that young ice has ceased to form. The shore ice and that in the bays breaks up and moves off from fifteen to twenty days after the pack disappears. In Norton sound the ice remains later, its time of departure varying with the strength and direction of the prevailing spring winds as much as three weeks on different seasons. Southerly and easterly winds clear the sound, and westerly winds pile the ice in.

Young ice ceases to form in the vicinity of St. Michaels, May 1. The earliest arrival recorded at St. Michaels is May 25, 1875, when a schooner, commanded by an experienced man, reached that place. Captain M. A. Healy, U. S. R. M., reached St. Michaels during two successive seasons on June 5 and 8, and it is generally expected that vessels will arrive there June 10–15. The Alaska Commercial Company's steamers, which are not fitted for encountering ice, leave Unalaska on their first northern trip about June 25, and reach St. Michaels safely, only encountering patches of drift ice through which they can easily pick their way.

In 1880, which was a westerly season, the *Corwin* met heavy ice, June 11, in latitude 60° 50′ N., and on July 9, when 16 miles from St. Michaels, was stopped by heavy ice which cleared away a few days later.

The heavy ice between St. Lawrence and Kings islands remains closely packed much longer than any other ice in Bering sea. It gradually melts and breaks up and sets north toward the straits at about one knot an hour, the last of it disappearing from July 5–15.

Port Clarence being a good harbor, close to the straits and free from ocean swell, is the rendezvous for the vessels of the Pacific

Steam Whaling Company's ships to meet the tender which supplies them with coal and provisions, and takes south the results of the spring catch. This bay, being well enclosed, clears of ice much later than the time of the departure of the pack along the shore. In 1885, the bark *Wanderer* anchored in port Clarence June 25, which is the earliest date that it has been navigable for years. As a general rule the tender to the whaling fleet arrives there July 1–5 without encountering any heavy ice.

Spring movements of the ice in Bering strait.—The current through Bering strait sets north, and, when not influenced by prevailing winds, its rate is about 2 knots an hour. Protracted northerly gales, lasting a week or more, are sufficient to change its direction southerly, but upon the cessation of these winds it quickly sets north again. Strong southerly winds increase its rate to 3 knots. In the spring the current on the east side of the Diomedes is the stronger, but the west side of the strait, on account of the west shore being cleared by the NE. current to the southward, is the first to clear of ice, and is given the preference by vessels proceeding north.

In 1889, the *Thetis* passed between East cape and the Diomede islands without sighting any ice July 3, but on July 6 she met numerous patches of drift ice setting to the northward between cape Prince of Wales and the Diomedes. Although in 1880 the first vessels passed through the straits May 22, and in 1881 vessels had reached latitude 68° N. by May 31, these were exceptionally early seasons, the usual time at which vessels find the straits navigable being June 15–25. Unless it is an unusually late spring vessels are sure to be through the strait by July 1, and, once through, the latitude of the Arctic circle is easily reached.

Spring movements of the ice in the Arctic ocean.—After passing through the strait the current on the east side takes a northeasterly direction, following the coast line and setting into Kotzebue sound; thence NW. along the coast to Hope point and around it, following the shore line up to Barrow point, where it goes off to the NE. On the west side of the strait the current branches off to the NW. and follows the Siberian shore up past cape Serdze and Koliutschin island, and thence off toward Herald island. The action of these currents is similar to that in the Bering sea, the pack breaking off first from the shore ice, at distances off shore varying from 2 to 10 miles, working off and on until it breaks up and goes north, followed later by the shore ice. Mention is sometimes made of an oval basin of open water of varying extent being found in the early spring, extending in a NW. and SE. direction on the Siberian side in the latitude of the Arctic circle. This probably exists every year, due to the retiring of the Arctic pack, the drift ice setting north from Bering sea being set off to the NE. and being insufficient in quantity to fill up both sides alike.

After passing through Bering strait the ice met is heavy, rough, hummocky ice, and vessels proceed cautiously, following the pack, and not getting between it and the shore ice if it can possibly be avoided. The pack moves north from both shores at about the same time, and cape Serdze is attainable, probably, a week before Hope point, which, as a rule, is reached by the first vessels bound north July 4.

Kotzebue sound, like all other enclosed bays, is blocked with ice later than the shore line to the northward of it, and its time of clearing depends upon the prevailing winds. A vessel, by following the shore line closely from cape Prince of Wales to cape Espenberg, working through the drift ice, which sets off shore and through Bering strait, may reach the sound by July 5, and it is generally navigable July 10.

In 1880, which was a westerly season, the sound was blocked by ice July 12, while in 1881 at the same date there was no ice to be seen there. As a general rule heavy drift ice coming out of Kotzebue sound is found between cape Blossom and Hope point up to July 12. The current between these points runs rapidly, carrying the ice along at the rate of from 2 to 3 knots, and banking it closely together extending 10 miles off shore at Hope point, after the pack has moved off from that vicinity.

In the vicinity of Hope point and cape Lisburne the pack breaks off about 3 miles from the shore, from April 5 to May 25, and moves off and closes in again with changing winds, gradually working off to the northward and westward. Young ice forms in the spaces thus left to about 5 inches in thickness, and gradually gets thinner until it disappears about May 15.

The time of departure of the shore ice varies greatly. In 1886 it moved off July 13, and in 1889, June 14.

By following the shore ice natives make the trip from Hope point to cape Lisburne in canoes as early as June 1, but it is not safe for vessels to enter the lead thus made until the solid pack has moved to the northward.

Drift ice remains in sight until July 10–25.

As the prevailing spring winds are southerly, there is always more or less open water close inshore in the bight to the eastward of cape Lisburne after May 1.

On account of the contour of the shore line and the banking of the Kotzebue sound ice around Hope point, with prevailing SW. winds, vessels can break through the strip of drift ice off cape Lisburne and find an anchorage off cape Sabine before they can make the Hope point anchorage. Hope point is the rendezvous of the New Bedford Whaling fleet to meet the tender sent up with supplies. The leading vessels generally reach there July 4, and the tender arrives from July 5–10, without encountering very much ice.

Vessels have arrived at cape Lisburne as early as June 17, and then again have been until July 25 getting to Hope point; but these were exceptional cases and probably illustrate the extreme cases of open and late seasons.

Whales are seen off Hope point as early as April 23, showing that ice holes must be plentiful at that early date.

From cape Beaufort to Barrow point, the pack moves gradually north, clearing from point to point. Vessels must not attempt to force it, but follow closely, being cautious not to get between it and the shore ice. A shift of wind to the westward brings the pack in on shore when a few hours before it was out of sight from the land. Off shore the pack moves to the northward more slowly.

The current setting along the Siberian shore changes to the northward and sets up toward Herald island at the rate of about one knot an hour, carrying the ice up in that direction, so that late in the fall it has formed a gap in the pack, extending about 30 miles north of Herald island, known as "the Hole." The result of this northerly current and the NE. current along the Alaska shore, combined with the prevailing summer SW. and SE. winds, is that the center of the pack in this Arctic basin moves slower than the sides, and, with the addition of drifting floes, a point of ice is formed, extending well to the southward. This point is found in from longitude 160° W. to 170° W., and is known as "Post Office point," as it makes a natural meeting place for vessels cruising to the eastward and westward to communicate and exchange news. On very open seasons, with prevailing southwesterly winds, Post Office point has been found as far to the eastward as longitude 157° W.

I have been unable to collect much data to determine the spring movements of the pack in the vicinity of Herald island. In 1881, which was an exceptionally open season to the westward, vessels were within sight of Herald island July 20; and on July 30 the *Corwin* landed men there, having passed considerable ice midway between there and cape Sabine. On August 12 of the same year she succeeded in forcing her way through very heavy floe ice and landed men on Wrangel island. In 1885, the *Corwin* met solid packed ice as far as the eye could reach, in latitude 69° 32′ N., longitude 174° 15′ W.

Following the coast north of Icy cape, vessels always have to take more or less risk. If the pack is not far off shore it is liable to shut in for several days at a time on the different capes, when vessels may anchor in the bights or moor to ground ice until the pack sets off shore again.

The dates of the probable arrival of vessels at different points vary greatly with different seasons. In 1879, about August 20, the fleet was stopped by the pack at Blossom shoals; a few vessels worked around, and about 15 miles into the bight to the eastward, but returned within a week.

On August 9, 1885, there was heavy drift ice on Icy cape, but vessels worked through it, and on August 10 anchored at Marsh point. On August 14 of the same year the ice was packed in solid on Franklin point, but vessels then between cape Smyth and that point lay safely under the lee of ground ice, and succeeded in getting south by August 19, when the pack moved off shore with a shift of wind and cleared the Sea Horse islands.

In 1881 the pack was in on Blossom shoals July 21, and on July 25 it was in sight from the shore 25 miles to the southward of Icy cape, and the "blink" was strong to the SW. This was an average season.

In the vicinity of Barrow point, during the early spring, the pack breaks off from the flaw, or shore ice, and moves off and on, young ice forming in the gap thus made until the middle of May. After the early part of June, when the pack moves off, it begins to take a NW. movement and continues to do so until it is gone. This movement on and off of the pack, continues until July 15, after which time heavily massed floe ice, much broken and closely jammed together, may be looked for. The shore ice leaves the beach July 15–25, but remains in sight until the middle of August, or perhaps all summer. On exceptional seasons the pack remains on the point all the year round. In 1879 and 1886 Barrow point was shut in.

In 1888 the steamer *Orca* reached the point July 4, which was the earliest arrival on record.

In 1880 the pack was only 4 miles off the point, August 25, when the first vessels arrived there. These are about the extreme dates of vessels arriving during seasons when the point is open, the average date of arrival being August 10–12.

To the eastward of Barrow point the conditions of the ice are very uncertain, and it is advisable for all vessels going out of sight of Barrow point to be prepared to spend at least one winter in the Arctic. When the pack moves off shore it does not proceed very far, and the shore and drift ice is found extending from its edge well inshore.

The currents from the rivers clear the bays of drifting ice, and strong winds from West to NE., by way of South, clear the pack from the different points.

Winds from West to NE., by way of North, bring the heavy floe and pack ice down on the points, and vessels so shut in are very liable to be imprisoned, especially should young ice set in before the southerly winds arise.

The current running along the west shore of Alaska sets off NE. from Barrow point, and to the eastward of that the movements of the ice are due entirely to winds, river currents, and "witch currents."

These "witch currents," which is the name given them by the whalers, seem to be peculiar to this locality. Some mention them as existing in the neighborhood of port Clarence, but I believe these to be only counter tidal currents. "Witch currents" are visible on the surface of the water as swirls and eddies, and are shifting and disappearing. Vessels in close proximity will be moved by these currents in different directions at the rate of 3 or 4 knots.

When the *Thetis* was moored to the ice off Lion reef large floes of ice, within a radius of ½ mile, were observed moving in three different directions, and were apparently uninfluenced by the wind, their motion being entirely due to strong local currents. At another time, to illustrate the danger attached to these currents, when moored to ground ice and riding head to wind with the drift ice setting by on either side and astern a large floe, under the influence of a "witch current," moved rapidly at right angles to the general ice movement, and swung in around the stern of this vessel before she could be gotten out of the way, completely enclosing her in heavy ice. She was worked clear in an hour and a half; but had young ice been forming at the time, the situation would have been attended with considerable danger.

Vessels have never been far enough off shore to ascertain if these "witch currents" are peculiar to shoal water only, but they are probably due to the changeable currents made by the eddies and counter currents in the wake of large bodies of ground and perhaps moving ice.

The winds to the eastward are generally local and, even when strong, are limited in extent; and vessels well to the eastward have no way whatever of telling the condition of the ice to the westward of them. Those who are drawing enough to push on to the eastward run considerable risk, being guided to some extent by the amount of northerly winds they experience, of finding the different points closed by ice upon their return. The local winds affect the ice very rapidly.

On the evening of August 10, 1889, the *Thetis* moored to ground ice off Cross island, the drift ice having a perceptible movement to the westward. During the night a strong westerly wind sprang up and by the next noon the ice was setting in heavy masses to the eastward at the rate of from 2 to 3 knots.

Again, after being shut in off Coopers island from August 19 to 24 by the main pack, which had shut down on Barrow point, thirty-six hours of light breezes from ENE. to SE. moved the ice off shore and opened a lead to Barrow point, so that vessels leaving Manning point four days later than this ship arrived twelve hours later at Barrow point without being forced to ram the ice at all.

A glance at the chart shows that Tangent point, cape Halket, Lion reef, and Martin point are the principal projecting points of the coast, and these are the points where the pack is found resting. If they are found clear a vessel can proceed, finding the ice well broken and scattered along the bays in from 5 to 8 fathoms of water.

By following this course the *Thetis*, in 1889, reached Mackenzie bay August 15, finding heavy floe ice off Tangent point, and later the pack; closely packed rotten ice off cape Halket; the pack about 4 miles off Lion reef, and about the same distance off Martin point. In the bays the "shore" and "floe" ice were found in greater or less quantities close inshore, except in the lagoons, until to the eastward of Herschel island.

It is not prudent for sailing vessels to go at all to the eastward of Barrow point, but when the ice is well open they venture as far as Tangent point.

An exceptionally open season occurred in 1878, when the sailing fleet all reached Camden bay.

The steam whalers go as far as the ice will allow them, their objective point being the mouth of the Mackenzie river. As a general rule they do not get farther than Return reef, and in 1888 succeeded in reaching Manning point. In 1889, which was an exceptionally open season, they went as far as Shingle point, Mackenzie bay, which is the first time this has been accomplished since 1850, when McClure and Collinson were searching for traces of Sir John Franklin.

In 1887 the ice was only open for two days from Camden bay to the Mackenzie river sufficiently to permit canoes to travel.

To the eastward of Herschel island clear water is found across Mackenzie bay. The current from the river holds the pack off, and all the ice in that vicinity is new ice formed every fall. This ice commences to break about May 20, and by June 1 it begins to thaw and the rivers commence running.

The pack breaks off from June 5–15, and the shore ice leaves July 1. Northerly winds may hold it in sight of the land for a few days, but by July 15 it is out of sight. This occurs every summer, and the line of demarcation between clear water and drift ice, bearing to the northward of Herschel island, is very pronounced. The natives report that this clear water extends off shore every summer 50 or 60 miles to the eastward of the Mackenzie river.

At Herschel island there is a perceptible tidal flow, the marks on the beach indicating a rise and fall of from 2 to 3 feet.

From July 15 until September 1 Mackenzie bay is clear of ice, then young ice forms, gradually increasing in thickness, and breaking up and moving off with variable winds. By September 20 it forms to 2 or 3 inches in thickness, and by October 1–5 everything is frozen solid for the winter.

Northern limit of southern edge of the pack.—During the latter part of August and the beginning of September the southern edge of the pack reaches its northern limit, the sea to the southward being clear of ice, excepting occasional small drifting floes. The general line of the pack is from Barrow point, on the east side, to cape North, on the west side, and is very irregular between these points, varying greatly during the different seasons.

Fall movements of the ice in the Arctic ocean.—Young ice forms earlier to the eastward than to the westward, and to the eastward can be seen as early as August 15, making in a thin skim between broken and floe ice on calm nights and disappearing in the daytime. By September 1 it forms to an inch in thickness, and after September 20 it forms rapidly.

The prevailing winds are northerly after the first week in September, and soon bring the pack down to the eastward of Barrow point. As soon as this fall movement commences vessels should proceed to the westward of the point at once. As a general rule, the steamers return to Barrow point by September 10. In 1888, which was a very open year, the steamer *Orca* came out from the eastward September 20, but this was unusually late, the latest on record.

Sailing vessels cruising along the ice pack generally leave Barrow point for the westward August 15–25, and steamers September 10.

In the vicinity of Barrow point young ice begins to form around heavy ice September 15, and by September 22 it forms in open water making rapidly along the beach after September 25. By this time the pack moves close inshore, scattering ice being found along the beach about September 10. The young ice makes out to the pack September 30, and then the ice is in for the winter.

From October 1 until December 1 the pack is continually coming in and moving off from one mile to out of sight. Young ice forms in the space thus made, which grinds and piles on the beach upon the return of the pack. After December 1 the ice makes fast to the bottom and stops grinding on the beach; a solid, stationary mass, which is termed the "flaw," extending from 4 to 8 miles off shore. On the edge of this flaw the pack continues to grind and pile, at intervals all winter, being set in by NW. gales and off by NE. gales. During these offsets it moves from one mile to out of sight, and remains open from one to fifteen days, according to the duration of the prevailing gales. When these movements occur the pack goes in a body with the current. The current in the winter sets, as it does in summer, to the northward during southerly and easterly winds. and to the southward with northerly and westerly winds, except that it changes oftener, generally running three days each way, there seldom being forty-eight consecutive hours without any current.

The pack shuts down on Icy cape by November 1, and after that time there is no open water between Barrow point and Icy cape, except when the flaw opens. During closed seasons these times may vary, but the above dates indicate the average season.

I may here mention a peculiar case of drift, which occurred in the winter of 1888–'89, which illustrates how the pack in this vicinity is constantly in motion all winter, and what different directions it takes. On August 3, 1888, during a heavy SW. gale at Barrow point the bark *Young Phœnix* lost her rudder and anchors, and drifted off into the pack and was abandoned. She was set off to the eastward and was last seen that fall 35 miles to the northward and eastward of Return reef, September 11. She was next sighted and boarded on July 9, 1889, about 8 miles to the southward of cape Smyth, being found firmly fixed in the middle of a floe 2 miles in diameter. From there she was set off and disappeared to the northward and westward. What her track was during the winter is a subject of conjecture.

Off shore and to the westward, in the vicinity of Herald island and Herald shoal, the movements of the pack to the southward are very uncertain after September 20, and are due altogether to the winds. Strong NE. winds produce a current to the SW., which carries the pack to the southward, and the loose ice to the SW., where it is set along the edge of the western pack. Strong NW. winds carry south the floe ice towards the strait, closing on both shores about alike.

Young ice commences to form to a thickness of an inch or more during the last week in September, and it is not safe for a vessel to be north of Herald shoal after October 1. After that date arms of the pack are liable to swing together and imprison a vessel; or loose floe ice, which was navigable during the day, will become so firmly fixed with young ice in a single night as to render it unnavigable even for steamers.

Instances of these kinds occurred in 1888 and 1879. In the former case thirteen vessels were cruising in the vicinity of Herald island until September 27, 1888, when, being warned by the "ice blink" that the pack was closing to the southward, they proceeded south through a narrow gap, and found that they were shut in; what they had thought to be clear water to the southward only proving to be another hole. The ice was heavy floe ice, frozen together by young ice, and would have been impenetrable had not an unusual event occurred for that season of the year, in the shape of a southerly gale, which broke it up. This was followed almost immediately by a strong NW. gale, and selecting the weakest point of the pack the vessels managed, by carrying on sail, to force their way out in the latitude of Herald shoal, longitude 175° W., on September 30.

The other case in which vessels were shut in in this vicinity was in 1879. The barks *Mt. Wollaston* and *Vigilant* were last seen to the northward and eastward of Herald island October 10, and were carried off in the pack, all hands being lost. Whether they were shut in by the pack or by young ice is unknown.

After September 26 young ice forms rapidly near Herald shoal, and after October 1–5, during calm nights or light northerly winds, it forms in thickness of from one to 6 inches in a single night. Being tempted by a scarcity of large ice during some seasons to remain in that vicinity a little later, vessels sometimes remain as late as October 10, or even later, but at times with disastrous results.

An instance of this occurred in 1879, when, on the night of October 18, the barks *Mercury* and *Helen Mar*, having worked clear of floe ice into open water, were shut in by young ice; it formed so rapidly that after it had been decided to abandon the weaker vessel, loads of a ton weight were dragged over the ice by parties of fifteen men, and the *Helen Mar* only succeeded in getting through the strait, November 1, by carrying royals during a close-reef gale, and driving through the quickly forming ice at the rate of one knot per hour.

These instances show that young ice is more dangerous in the late fall than the movements of the solid pack, and the limit of safety for vessels cruising in this vicinity is October 1 at Herald shoal. After that time they should work steadily to the southward.

A vessel once caught in the pack in this vicinity is carried off to the northward and westward, and it is only a question of time when she will be broken up and sunk by the working and grinding of the ice.

In longitude 170° W., the main pack seldom comes in a body below latitude 69° N., but vessels coming south in the late fall usually encounter heavy floe ice between cape Serdze, on the Siberian shore, and Hope point, on the Alaska shore. The northeasterly and northerly winds drive the loose floe ice from the edge of the pack along the western pack and down on the Siberian shore. Here it takes a turn to the SE. and follows the shore, in a southeasterly current thus made, until it reaches cape Serdze, where it is deflected off to the eastward toward Hope point, where the current turns it to the northward.

This accumulation continues increasing during the fall until young ice gets too heavy to allow the floe ice to be influenced by the wind. It banks heavily on the Siberian shore, and when met by vessels bound to the southward, is only avoided by working to the eastward, vessels sometimes having to pass very close to Hope point, and, in a few cases, well in toward Kotzebue sound, to pass around and get to the southward of it.

Vessels bound south from Herald shoal, steer to make a landfall at cape Lisburne or Hope point, in order to set a course for the strait and make use of soundings, and by so doing they generally avoid this accumulation of heavy ice. Strong northerly gales drive this loose ice down in the vicinity of the strait, northeasterly gales banking the west side, and northwesterly gales both sides alike.

In the vicinity of cape Sabine, young ice commences to make October 10–20. It moves off and on with southerly and northerly winds, the current rapidly changing its direction with shifting gales, until the early part of January, when it becomes fixed to the shore and remains so until it breaks up in the spring.

At Hope point the ice forms in the lagoons about September 25, but young ice in the ocean is as late forming as October 12, being heavy by October 25.

All the ice in this vicinity in sight from the shore is made up of young ice, which telescopes and piles until it forms heavy floes, the gaps freezing over with young ice and forming heavy pack ice by early spring. Occasionally a few scattering floes of old ice are drifted into this vicinity and held by the young ice, but as a rule it is all new ice.

Under the cliffs between cape Lisburne and Hope point, temperate springs exist which cut away the sea ice and keep a place of open water all winter.

Kotzebue sound freezes over and is closed to navigation by October 10–15.

Fall movements of the ice in Bering strait.—The regular set of the current in Bering strait in the fall is northerly, being stronger on the east side; but, the prevailing gales at this season being northerly, a change in the direction of the current to the southward is more common than in the spring. Northwest gales drive the loose ice down into the strait on both sides alike, but vessels leaving Herald shoal October 1, after passing the ice between cape Serdze and Hope point, seldom find enough heavy ice in the strait to retard their progress south. More ice is found on the east than on the west side, but the east side is perferred on account of the contour of the bottom being better suited for soundings in thick weather.

An instance of the strong southerly current which is found existing in the strait after a protracted NW. gale is given by a whaling captain. While running from cape Serdze to make the Diomedes, he raised Kings island instead; thinking it was the Diomedes, he swung off to the southward, and, when he had run up his distance for Kings island, found himself off Northeast cape of St. Lawrence island. This instance shows conclusively a SE. current on the Siberian coast and a southerly current in the strait.

All vessels, steamers or sailing vessels, should be out of the Arctic by October 10. Cases have occurred in late seasons where vessels have voluntarily been as late as October 23 passing through the strait; or, as in the case of the *Helen Mar*, in 1879, until November 1, at which time she forced her way through rapidly forming ice with great difficulty; but October 10 is as late as safety will permit of a vessel being north of Bering sea. After that time the ice forms and banks in the strait rapidly, alternately being solid across and then breaking up in leads and holes.

During these periods of solid ice the natives communicate across it from cape Prince of Wales to East cape. Such trips are always accompanied with much danger, but are accomplished by the Prince of Wales natives making a forced march to the "Little" Diomede, where they meet the natives of the "Big" Diomede, who have in turn been visited by the natives from East cape. These trips are made annually.

Fall movements of the ice in Bering sea.—In the northern part of Bering sea young ice commences to form in small quantities in the bays and along the shore about October 15 as far south as Indian point. In St. Lawrence bay, after October 25, when the northerly winds prevail, it forms quite solid along the shore, while it still remains not solid enough to travel on in deep water. In 1881 it remained in this condition until November 31, too heavy to work a boat through, but too light to travel on, when in one night it froze solid. Very few pieces of old ice are seen, the whole formation being young ice which piles into heavy masses.

December 1, the ice is solid for the winter, the pack breaking off from 6 to 8 miles off shore, with shifting winds, until the spring southerly winds start it north. When the pack comes in at these times it forces the ice up 20 and 30 feet, forming hummocks of heavy ice. Off shore young ice, of sufficient thickness to impede and perhaps prevent a steamer's progress, forms from November 1-15, and at St. Lawrence island November 25.

On the east side of Bering sea, in Norton sound, and in the vicinity of St. Michaels, young ice forms in small quantities October 12-18, and by October 25-28 is strong enough to travel on. It forms for a "full due" for the winter between November 1-10, and St. Michaels is considered closed to navigation for the winter after October 15.

All the ice found in Norton sound is made up of young ice, which forms every fall and entirely disappears during the following summer.

The ice continues to form, extending farther and farther to the southward, breaking up, piling, and telescoping with variable winds and currents, and so forms the Bering sea pack, which has its limit, as a solid mass, a little to the southward of St. Matthew island. To the southward of that, the ice found consists of detached floes, which are driven off from the mouths of the rivers on the Alaska side.

At Pribilof islands it takes fully three weeks of northeasterly winds to drive the ice down on the islands, a NW. wind being unaccompanied by ice. This ice is looked for during the latter part of December or early January, and is continually in motion, with variable winds, being much broken up.

Some years the islands are free of ice.

The farthest south the ice has been ever known to extend is Akutan pass, and this occurred about January 15, 1878, when it only remained a few days.

PART II.

OBSERVATIONS ON THE PRINCIPAL ROUTES IN THE PACIFIC OCEAN.

CHAPTER I.

ROUTES FROM SOUTH TO NORTH ON THE WESTERN COAST OF AMERICA.

§ 44. **Route from cape Horn or the strait of Magellan to Valparaiso.**—After having doubled the cape, and while making to the northward, it is a good plan to make the westing so as to cross 50° S. rather to the westward than to the eastward of 80° W.; but this parallel may be crossed at 79°, or even 78°, though it is not desirable to do so. After passing 50° S., keep to the northward, following 80° W., as nearly as the sea and dominant winds from NW. to SW. will allow. Beyond 45° S. it is best to keep between the meridian 78° 10′ and 79° 40′ W. Cross the parallel 40° S., near 78° 10′ or 78° 40′ W., then continue toward the north till you reach 37° 30′ or 37° S., thence make your easting and cross 35° S., between 74° 40′ and 75° 10′ W. From this point you can proceed without difficulty toward Valparaiso, merely making allowances for the leeway and current, which usually set to the northward and are apt to cause errors in the course.

Though it will generally be found easy to follow this route, as above described, we will give the difficulties to be encountered at each season of the year and the course it is best to pursue in each case; § 21 gives the prevalent winds of this region.

In January it is advantageous to cross 50° S. a little to the westward of 79° 40′ W., as winds from NW. and NNW. rarely prevail in that locality. But between 45° and 40° S. it is preferable to keep to the eastward of that meridian, where the winds are often more favorable. Calms and baffling airs are frequent during this month.

In February it is still more important, if it be possible, to cross 50° S. to the westward of 79° 40′ W. It may be generally stated that vessels will make this passage from cape Horn to Valparaiso much more rapidly if they cross the parallel of 50° S. even much farther to the westward. Thus quick passages can be made under canvas when 50° S. is crossed at 80° 40′ W. or to the westward of that meridian; 45° S. at between 80° 40′ and 81° 10′ W.; 40° S. between 79° 40′ and 80° 10′ W.; then 35° S. at about 74° 40′ W. In crossing the parallels at these points do not hug the NW. wind too closely, as there is danger of being driven to the eastward of the advised route. If the wind afterward shifts to the West and SW., it is evident that you would not voluntarily lay as high as NW. to regain the points of crossing. You should merely try not to get too far from them.

In March the best route is, on the other hand, to the eastward of 79°

40′ W.; it will therefore be sufficient to cross 50° S. just far enough to the westward to avoid the land in case of several successive squalls from the west. This point should be left to the discretion of the captain; a sailing vessel might pass near 78° 40′ or 78° 10′ W., while a vessel with auxiliary steam power would find no difficulty in crossing at 77° 40′ or 77° 10′ W. The winds are generally steady and favorable; yet there are always chances of winds from NW. In case the wind does come out from NW. keep on the port tack as long as it can be done with prudence. On the one hand, be very careful not to get too close to the shore; on the other, remember that there is more chance of finding favorable winds near shore than out at sea in the neighborhood of 80° W.

Thus 50°, 45°, and 40° S. may be successively crossed at the meridian of 77° 10′ W.; the rest of the passage is easily made, crossing 35° S. at about 75° 10′ or 74° 40′ W. Calms and light airs are the only causes for detention north of the 35th parallel.

In April the same general route, given for the whole year, should be followed.

We would merely remark that, at this time, between 50° and 35° S. the wind prevails more from NW. than during the first months of the year. This should therefore be borne in mind to profit by any favorable wind in order to keep as much as possible to the westward of 79° 40′ W. between 50° and 45° S.; and to the westward of 78° 40′ W. between 45° and 40° S. With this precaution it is possible to continue on the port tack when the wind comes out from NW.; cross 35° S. near 75° 40′ W., and 34° S. between 74° 10′ and 74° 40′ W. North of 35° S., on nearing Valparaiso, calms are less frequent than earlier in the year, the winds blowing steadier from NE. to North and NW.

In May, as in February, it is best to make the northing to the westward of 79° 40′ W., when the winds permit. May is not a bad month if the route prescribed for February be followed. Near Valparaiso this is the winter season.

In June, as in February and May, it is advisable to cross 50° S. as far as possible to the westward. Between 50° and 45° S. the winds are more favorable to westward than to eastward of 79° 40′ W.; besides it is best and nearly always possible to profit by all the fair winds in order to cross 45° S., and particularly 40° S. near 80° 40′ W. This advice is considered important, for in June the winds very often blow from NNE. to NNW. between 40° S. and Valparaiso. A vessel will not really be in a very good position to fetch this port under sail if she steers to the northward of NE.

It is well known that West and SW. winds are to be found between 40° S. and Valparaiso, and that in all cases the current is favorable.

In July and August the same observations hold true. The only remark to make is that during August there is no necessity of crossing 50° S. very far to the westward, as the wind is generally favorable between 50° and 45° S. to both the eastward and westward of 79° 40′ W. But it is prudent and always possible to cut 45° S. between 79° 40′ and 80° 40′ W.; and afterward 40° S. at the same longitude as has been stated for June.

In September it is easier to make the passage—between 50° and 45° S.—by sailing to the westward of 79° 40′ W., as here the winds prevail from West and SSW., whereas to the eastward of this meridian they are from NW. After passing 45° S. the general route given for the whole year may be followed without difficulty; 40° S. should be crossed between 77° 10′ and 79° 10′ W.; thence the winds are fair and steady.

In October, as in September, it will be more advantageous to cross 50° S. to the westward of 79° 40′ W. Settled and favorable breezes will nearly always be found in crossing 45° S. between 80° 10′ and 81° 10′ W.; 40° S. at 79° 40′ W.; and 35° S. at 74° 40′ W.

In November the passage is slow and tedious. The general remarks which are given on the proper route to be followed during the whole year apply particularly to this month. It is only to be noted that at this time the NW. winds are frequent from the parallel 50° to 35° S., and both to the east and west of 79° 40′ W. Still it is better to cross 50° S. to the westward of 79° 40′ W., when it can possibly be done. As a general rule advantage should be taken of every favorable slant in the wind that may help the vessel to the northward and westward, for then a long stretch may be taken on the port tack when the wind comes out from NW. If possible cross 40° S. at about 78° 40′ W., as the wind is better to the eastward of 79° 40′, between 40° and 35° S. Beyond this point the voyage will be easily made.

In December the same observations as for November. The winds will be found favorable, and from West, SW., and South, after leaving 40° S., if that parallel be crossed to the eastward of 79° 40′ W., or even at 78° 40′ or 78° 10′ W.

II. *Routes after leaving the strait of Magellan.*—The route through the strait of Magellan is always taken by steamers, or auxiliary steamers, when the consumption of coal is a secondary consideration. Consequently the passage from cape Pillar, or the gulf of Peñas, to Valparaiso, presents no serious difficulty.

Steamers can make their northing, merely taking care to keep at a safe distance from land, that they may not be driven ashore in case of bad weather. As for vessels with auxiliary steam power, they first make to the westward, steering on a WNW. or NW. course, either under steam or sail, if the winds allow. No other advice need be given for the beginning of this route, except to profit as much as possible by every favorable wind, so as to get away from the coast, when the fires may be hauled and the voyage continued under sail. The more the coast is left (as far as 79° 40′, if it is possible), the more chance there is of making a quick passage to the northward.

When auxiliary steamers leaving cape Pillar shall have gone far enough to the westward and made sail, their route will not differ greatly from that of sailing vessels coming from cape Horn. This route, however, will be two or three degrees more to the eastward, and will be made under less favorable circumstances, the wind being more ahead, as may be seen by referring to the observations at the beginning of the present section. This observation is still more applicable to vessels, with both steam and sail power, entering the Pacific by the gulf of Peñas, as their route is still farther to the eastward, and as it is advantageous, during nearly every month of the year, to keep well to the westward after passing cape Horn under sail.

The most prevalent winds, and those which are most to be feared as head winds, come from NNW. and NW. It is therefore advisable to take advantage of every favorable breeze, after leaving the strait of Magellan, in order to make to the westward and to the northward If this be done, a long stretch can afterward be made on the port tack without fear when the wind comes out from NW. And we repeat, there will be no serious difficulty—to a ship that can, if it becomes necessary, start ahead under steam and fore-and-aft sail—in taking the NNW. wind four points on the bow. The use of sail and steam combined has simplified all these routes, and there are no special points of crossing to be recommended for auxiliary steamers.

§ 45. **Route from cape Horn or the strait of Magellan to ports north of Valparaiso and south of Callao.**—The route to be followed to reach these ports is nearly the same as that prescribed for making Valparaiso (§ 44). The vessel should be steered so as to make land about 28° or 30° S. (unless the destination be Coquimbo); thence follow the coast with a steady wind from South and SE. (§ 22), keeping between 5 and 15 miles from shore. The position can always be obtained by sighting the land, and a good landfall can be made, which the winds and currents might prevent if the off shore routes were followed.

If it is not deemed advisable to approach the land so far to the southward of the destination, steer for the island of Juan Fernandez. Here the chronometers can be corrected, and the main land afterward approached with greater assurance.

§ 46. **Route to Callao.**—Ships bound to Callao from cape Horn or the strait of Magellan will first steer as if they were going to Valparaiso. Their route will only be different after leaving about 40° S. (§ 44); from this parallel they will, if possible, steer a little more to the northward. We will, however, give a few observations relative to this passage, for each season of the year; these will complete those given in § 44.

In January, after having crossed 50° S. at 79° 40′ W., or even a little to the westward of that meridian, if possible, ships coming from cape Horn should shape their course so as to cut 45° S. at 79° 40′ W. Between 45° and 40° S it is preferable to keep to the eastward of 80° W, where the winds would appear to be steadier and more favorable than farther to the westward. Cross 40° S. at 77° 40′ W., and make the northing from 40° to 30° S., between 77° and 80° W., as the winds near those meridians are more favorable. A light SSW. to SSE. wind will probably be found near 30° S. and 77° W., which will shift to SE. beyond 25° S.; thence the passage to Callao will be easily accomplished.

In February, after having crossed 40° S. near 70° 40′ W., there is no better rule than to sail immediately to the northward. In case winds blow from North or NW., which rarely happens, keep the sails full. The wind is sure to shift to its usual quarter, WSW and SW. Between 40° and 35° S. the wind is more favorable and steadier east of 80° W. than to the westward of this meridian; the reverse is the case between 35° and 30° S. Beyond 30° S. the wind will always be favorable. The 30th parallel should be crossed between 78° and 80° W.

In March, beyond 40° S. and 78° 10′ or 78° 40′ W., the winds will be generally favorable, though as far as 30° S. they frequently blow from NW. Make as much northing as possible without hugging the wind too closely, and keep between 76° and 80° W.

When there are leading winds it is well to keep as closely as possible to the meridians 79° and 80° W., so as to prolong the port tack in case of a series of winds from NW. or NNW.

It is also important not to cross 30° S. to the westward of 80° W.; this parallel should be crossed between 77° and 80° W. The winds will constantly be favorable from this point to Callao.

In April, after having reached 35° S., near 76° W., steer to the northward. The wind will be generally favorable, though frequently from NNE. to NNW. It is advantageous to cross 30° S., between 73° 10′ and 74° 40′ W. From this point steer so as to cross 25° S. at 74° W.; the winds here are always steady between SSE. and SSW.; thence the winds are favorable. Though this route is more easterly than those for the preceding months, still it is advisable to follow it, as NW. winds are common between the parallels 30° and 25° S., and west of 75° W. This unfavorable direction of the wind is even more noticeable farther to the westward.

In May, if it is possible, cross 40° S. between 78° 10′ and 78° 40′ W. From 40° to 30° S., the winds usually vary from NNE. to NW. and WNW., occasionally interrupted by winds from SW.

Unfavorable northerly winds are still more frequent, and the breeze less to westward of 80° W. It is therefore well to keep between 78° and 80° W. in making to the northward, and to choose that tack which will help most to run down the latitudes. After having crossed 30° S. near 79° W., the dominant winds are from SE.; they will become steadier as the vessel makes to the northward, though there is always a chance of finding a breeze from NNE. to NW. as far as 20° S. This month corresponds to the beginning of the winter season.

In June, 40° S. should be crossed to westward of 80° W., if possible at 81° or 82° W. The parallel of 35° S. should be crossed if it can be done between 80° and 83° W.; here the winds blow nearly as often from North and NNW. as from SW. To the eastward of 80° W., the chances are not so good. Beyond 35° S. the winds are generally favorable to 30° S., which you should try to cross between 78° 10′ and 80° 10′ W. Afterward continue to steer to the northward, keeping to eastward of 80° W.; the winds will be throughout favorable.

In July, cross 40° S. and 35° S. between 80° and 82° W.; 30° S. between 78° and 80° W., and 25° S., between 77° and 80° W., taking care, however, not to go farther to the westward. These crossings, or rather this large belt, would seem to be the most favorable for vessels making passage to the northward under sail. However, North and NW. winds are always to be expected at this season, and often keep vessels jammed on the wind until they have passed 25° S.

In August, also an unfavorable month, the following crossings are. however, the best: 40° S. between 80° and 82° W.; 35°, 30°, and 25° S., crossed successively between 77° and 80° W. Between 40° and 35° S. there is apt to be a series of winds from NNE. to NW., while southerly winds prevail between 35° and 25° S. Beyond 25° S. the winds are generally favorable.

In September make as much northing as possible between 40° and 30° S., keeping, as much as circumstances will allow, between 77° and 79° W. The winds often blow from SW., but there will sometimes be a series of NW. winds, though they are less common than during the preceding months. Beyond 30° S. the wind is favorable and from South to SE.

In October cross 40° S. near 79° 40′ W. if possible. After passing this parallel make to the northward, keeping between 79° and 82° W. In this part of the route the winds are almost always favorable, varying generally from WNW. to SW., South, and SE. Cross 30° S. at about 80° W.; thence the winds predominate from South to SE.

In November it will be found better to cross 40° S. east of 80° W., as the winds are here a trifle better than to the west of the meridian; besides farther to northward the NW. winds become rarer, and are inclined to shift to SW., South, and SE. After crossing 30° S., between 77° and 80° W., southerly and southeasterly winds predominate.

In December the same route is advisable, with this difference that it is still more important to cross 40° S. east of 80° W., between 78° and 80° W., for example. You will generally find favorable winds from some point between WSW. and South. NW. winds are rare. The chances are even more favorable north of the parallel 35° S.; here the wind frequently blows from SSW. to South and SSE. Beyond 30° S., which should be crossed between 77° and 78° W., steady South and SE. winds prevail.

§ 47. **Route from cape Horn or from the strait of Magellan to Paita and Guayaquil.**—The instructions given in §§ 44 and 46 should be followed. SE. trades are met at about 30° S.; afterward steer directly for the port, with favorable winds; or sight Lobos de Afuera" and Aguja point, afterward passing close to cape Blanco if the destination be Guayaquil.

§ 48. **Route from cape Horn or the strait of Magellan to Panama.**—The observations given in §§ 44 and 46 are applicable as far as about 30° S., where steady trades will be encountered from South and SE. The route then passes about 30 or 40 miles from Aguja point and cape Blanco. Thence head to the northward, with leading winds, so as to make cape San Francisco if need be. In this neighborhood the land is high, bluff, and covered with large trees; the sea breeze blowing from South, the land breeze from SSE. To the southward of the line, say 5° S. of the equator, the winds are nearly always favorable; still be on the watch for northwesterly winds, as they sometimes blow from February to June. During these months it is advisable to pass about 100 or 150 miles from cape Blanco, so as to be able to make a good stretch on the port tack; rap full if you happen to have a NW. wind. When the wind blows from NNE. or NE., which, however, seldom happens except in May, keep well full on the starboard tack. North of the line the winds are generally favorable, except in January, February, and March, when they frequently blow from the northward. (For winds see § 23.)

From cape San Francisco head for the Pearl islands, but remember that the currents make the land full uncertain, as at the mouth of the gulf they are always more or less affected by the prevailing winds.

During the fine season, when the NE. wind is well established, that is after the beginning of January, the currents set to west. During the winter, on the contrary, the prevalence of the SW. winds makes an easterly current. In both cases their strength is sufficient to make grave errors in navigating. Apart from this uncertainty of the currents the gulf of Panama is easy of access. The passage from the southward to Panama bay is easily made during the greater part of the year; but in the fine season, when within the influence of the northers, the following plan should be adopted: make short tacks inshore as there is generally a set to the northward found within a few miles of the land, and where that is interrupted a regular tide is exchanged for a constantly contrary current farther off. Between Chirambira point and cape Corrientes the land is low and faced with shoals, caused by the mouths of the numerous rivers which have their outlets on this part of the coast; but after passing cape Corrientes, it may be approached pretty closely, except off Francisco Solano point, where some rocky shoal patches extend to seaward, as the coast is in general bold-to. Care, however, should be taken not to run into the calms caused by the highlands, as it is difficult to get off into the breeze again and the swells set inshore, where it frequently happens that no anchorage is to be found till close to the rocks.

In beating up the bay of Panama in the fine season the eastern passage, or that between the Islas del Rey and the main land, is to be preferred, as, with one exception, it is free from dangers. The water is smooth, and a regular tide enables you to make more northing than it would be possible to do, in nine cases out of ten, against the strong current and short high sea which at this season prevail in the center or on the western side. During the rainy season a straight course up the bay is preferable to entangling yourself with the islands, the current generally following the direction of the wind.

§ 49. **Route from cape Horn or the strait of Magellan to Acapulco, San Blas, and Mazatlan.**—A vessel bound for the western coast of Mexico, safely round cape Horn and running before the southerly gale which almost constantly blows along the shore of South America, ought to shape a course so as to cross the equator in about 98° or 99° W. long., so that when she gets the NE. trade she will be at least six or seven degrees to the eastward of her port, San Blas, or Mazatlan, and have at the same time a sufficient offing from the Galapagos islands to avoid their currents and variable winds.

Care must be taken in standing in for land not to get to leeward of San Blas, as there is a strong southerly current along the coast, especially off cape Corrientes.

These instructions are meant for vessels bound to San Blas or Mazatlan. Those bound to Acapulco, Istapa, or Realejo should cross the line more to the eastward, where, however, calms are common, particularly near the Galapagos islands in January, February, and March. It will therefore be advantageous to cross the equator between 86° and 88° W., if running for one of the southern ports of the Mexican coast, or about 98° W., if bound to one of the northern. Steamers can, of course, run through the "doldrums" whenever most convenient.

We will give in section 61 remarks of Captain Wood on the passage between the Galapagos islands and cape St. Lucas. Information on the winds and currents of this passage may also be found in §§ 1, 24, and 39.

In January, February, and March, from a careful study of the wind charts, the following facts are deduced concerning the voyage from the line to the port of destination. In January, February, and March ships bound to Acapulco, San Blas, and Mazatlan should cross the line at about 100° W. They should steer, the winds being strong and steady from SE. and South, so as to reach 10° N. near the meridian of their port. If they are going to Acapulco, they should cross 10° N., between 101° and 103° W. Thence, till they make the land, they will have from 6 to 7 per cent. of calms, and NW., North, and NE. winds. Ships going to San Blas and Mazatlan should cross the parallel of 10° N. between 105° and 107° W. Beyond this point they are liable to about 5 per cent. of calms and variable winds from NE. to NW.

During this season vessels bound to Istapa and Realejo should cross the equator between 85° and 87° W. They will then have about 5 per cent. of calms, and variable SE. and South winds. The parallel of 10° N. should be crossed to the eastward of the meridian of Istapa or Realejo, as the case may be; as NE. and NW. winds are common north of 10° N., ships keeping to the westward of 78° or 80° W. are very likely to be becalmed after passing 10° N.

In April, May, and June, vessels bound to Acapulco should cross the line in the neighborhood of 97° or 98° W. Thence they will be able to make quick time to the northward, with the wind quite steady from SE. and South.

They should reach 10° N. at about 97° W., and will be exposed to more and more calms as they sail to the north; especially if they run to the westward of the meridian 98° or 100° W. The southerly winds die away on approaching Acapulco, and come out from East, NE., and North. This is a very long and tedious passage for sailing vessels.

Vessels bound to San Blas and Mazatlan should cross the equator at about 98° W. They should then steer so as to cross 10° N. between 100° and 102° W.; the SE. breeze dying away toward the parallel of 10° N. North of 10° N. it is usually calm, though light airs are found, especially from NE. to North, as far as 20° N.; beyond this parallel steady West and NW. winds generally prevail. Ships are sometimes becalmed for a long time between 10° and 20° N.

Ships going to Realejo and Istapa should cross the equator between 85° and 87° W. From this point they can easily steer for their destination with southerly winds, varying at times from SW. to SE.

In July, August, and September the route for vessels bound to Acapulco is shorter than that of the preceding months. They should cross the line at about 96° or 97° W., and steer with the variable southerly and southeasterly breeze so as to reach 10° N. at 98° W. Thence they will be exposed to more and more calms as they approach and pass 100° W. In the neighborhood of 15° N., variable NW. and SE. winds may be expected.

Ships bound to San Blas and Mazatlan should cross the line in the neighborhood of 100° W. The SE. trades are here prevalent, and will be kept as far as 10° N. This parallel should be crossed at about 107° or 108° W. Beyond 10° N. there are about 6 per cent. of calms, and the prevailing winds are westerly, varying from NW. to SW. If possible cross 15° N. at about 108° or 109° W. Beyond 15° N., NW. winds are common as far as Mazatlan or San Blas. The chance of meeting calms will be at first 6 per cent.; it will afterward increase, and reach as high as 11 per cent. beyond 20° N. If the above crossings be followed the last part of the passage will be rendered easier, for the course can be laid at NNE. on the port tack.

Ships bound to Istapa and Realejo should cross the equator at about 85° W. They will find very favorable southerly winds, varying from SW. to SE., until they reach their anchorage.

In October, November, and December vessels going to Acapulco should cross the line near 96° or 97° W., and then, with favorable winds from South to SE., head for 10° N. at about the same longitude.

Beyond 10° N. both easterly and westerly winds are frequent with 5 per cent. of chances of calms. On approaching 15° N., which should be crossed between 98° and 99° W., the chance of meeting calms and NW. winds becomes much greater. The latter part of this route can be greatly shortened by vessels with steam power. We do not think that even sailing vessels need follow a more westerly route; for west of 100° W., and north of 10° N., there are 9 per cent. of chances of calms, and NW. and NE. winds.

Vessels going to San Blas and Mazatlan are obliged to make their northing in the unfavorable belt above mentioned. They should cross 10° N. near 106° or 107° W., where they will have steady winds from SE. They should then try to get as far as possible to the northward, taking advantage of the NW., North, and NE. breezes, and, going about whenever they can, make to the northward.

Vessels bound to Realejo or Istapa will make good headway with the southerly winds, from the line—between 86° and 88° W.—to 10° N., crossed a little to the westward of the port of destination. The wind becomes variable after passing this parallel; in fact, westerly winds are the commonest, the usual directions being NNE., NNW., NW., and sometimes WSW.

§ 50. **Route from cape Horn or the strait of Magellan to San Francisco.**—The California-bound vessels should aim to enter the SE. trade-wind region of the Pacific as far to the west, provided they keep on the eastern side, say, of 118° W., as they well can; they should not fight with head winds to make westing, nor should they turn much from the direct course when the winds are fair. But when winds are dead ahead they should stand off to the westward, especially if they be south of the trade-wind region. Having crossed the parallel of 35° S. and taken the trades the navigator, with the wind quartering and all sails drawing, should now make the best of his way to the equator, aiming to cross it between 105° and 120° W., according to the season of the year and the directions and tables hereinafter given.

In urging upon California-bound vessels the importance of making westing about the parallel of 50° S., it is not meant that they should expose themselves to heavy weather, or contend against adverse circumstances, in order to get west on this part of the route, but simply that if a vessel after doubling the cape, can steer a WNW. course as well as a NW., or a NW. as well as a NNW., or a NNW. as well as a North course, that she should on all such occasions give preference to the course that has most westing in it, provided she does not cross 50° S. to the westward of 100° W. or thereabouts, nor 30° S. to the westward of 115° W., nor enter the SE. trade-wind region to the west of the last-named meridian. This is the western route, and is to be preferred by all vessels at all seasons.

Between the equator and 10° and 12° N., according to the season of the year, the California-bound navigator may expect to lose the SE. and get the NE. trade winds. He will find these last nearest the equator in January, February, and March; but in July, August, and September he will sometimes find himself to the north of the parallel of 15° N. before he gets fairly in the NE. trades, and sometimes, especially in summer and fall, he will not get them at all, unless he keeps well out to the west. Having them, he should steer a good rap-full, at least, aiming, of course, to cross the parallel of 20° N. in about 125° W., or rather not to the east of that, particularly from June to November. His course, after crossing 20° N., is necessarily to the northward and westward until he loses the NE. trades. He should aim to reach the latitude of his port without going to the west of 130° W. if he can help it, or without approaching nearer than 250 or 300 miles to the land until he passes out of the belt of the NE. trades and gets into the variables, the prevailing direction of which is westerly.

The Farallones, seven small islands, about 30 miles from San Francisco, are in the fairway to the harbor. They afford a fine landmark, and should be made by all inward-bound vessels. Vessels upon approaching the heads of San Francisco, especially in the winter months, are liable to be beset by fogs, and delayed for many days.

Between the coast and the meridian of 130° W., from 30° to 40° N., the prevailing direction of the wind in summer and fall is from the northward and westward; whereas, to the west of 130° W., and between the same parallels, the NE. trades are the prevailing winds for these two seasons. There is a marked difference in the directions of the winds on the opposite sides of the meridian of 130° W. in the North Pacific.

Vessels bound to San Francisco should not, unless forced by adverse winds, go any farther beyond the meridian of 130° W. than they can help.

Supposing that vessels generally will be able to reach 30° N. without crossing the meridian of 130° W., the distance per great circle from cape Horn to its point of intersection with that parallel is about 6,000 miles.

And supposing, moreover, that California-bound vessels will generally, after doubling cape Horn, be able to cross the parallel of 50° S. between the meridians of 80° and 100° W., their shortest distance in miles thence to 30° N., at its intersection with the meridian of 130° W., would be to cross 40° S. in about 100° W.; 30° S. in about 104° W.; 20° S. in about 109° W.; the equator in 117° W.; and 30° N. about 130° W. (126° if you can). By crossing the line ten degrees farther to the east or ten degrees farther to the west of 117° W., the great circle distance from cape Horn to the intersection of 30° N. with 130° W. will be increased only 150 miles.

Navigators appear to think that the turning point on a California voyage is the place of crossing the equator in the Pacific. But the crossing which may give the shortest run thence to California may not be the crossing which it is most easy to make from the United States or Europe.

After entering the SE. trade-wind zone it is perfectly easy to steer for the equatorial crossing; it is an open question at which point it is best to cross, but the westerly route, west of 110° W., seems to be generally preferred and should always be taken.

In January, February, and March cross 10° N. between 120° and 123° W. To the southward of this point the trades blow; but soon after leaving 10° N. the wind will come out steady from NE.

The change will generally take place without an intervening calm. Vessels will be able to steer a little free through the NE. trades; as 20° N. will not have to be crossed to the eastward of 128° W., nor 30° N. to the eastward of 133° W. Beyond 30° N. the wind will become variable, first hauling to ENE. Make as much to the northward as possible; but do not attempt to make any easting until the region of westerly winds, or what is generally the same, the latitude of San Francisco is reached.

In April, May, and June cross the line between 118° and 123° W. Here the wind prevails from SE., and the course can be laid to reach 10° N., between 123° and 125° W. Thence keep the sails well full, with the NE. trades, which will often haul to North, and stand on the same track to 30° N., between 133° and 138° W.

The last part of the passage will be the same as that for the preceding months; and the winds will not generally become favorable, or westerly, south of 37° or 39° N.

In July, August, and September the best point to cross the line is about 125° W.; and the parallel 10° N. at 130° W. The SE. trades will be carried across the line and as far as this latter parallel; but from 10° to 20° N., about 7 per cent. of calms and prevailing NE.

breezes may be looked for; SW. winds have also been found in this locality. Cross 20° N., between 133° and 136° W.; beyond this parallel the steady NE. trades will be found, and the attempt should be made to cross 30° N. near 140° W. After this the wind may be very variable in direction, though probably from the northward and eastward as far north as 34° or 36° N., where the first puffs of the westerly wind will be felt. To make a quick passage run well up into the zone of West winds, and make the easting to the northward of the parallel of San Francisco.

In October, November, and December the equator should be crossed near 113° W.; and 10° N. between 118° and 120° W. The SE. trades will be carried to nearly 10° N., vessels usually running from one set of trade winds into the other without any intervening calms; then keep a point or two free, and cross 20° N. between 127° and 129° W. It will, however, be necessary to lay a little closer when between 20° and 30° N., so as to reach the latter parallel at 133° or 134° W. As the wind becomes variable north of 30° N., advantage should be taken of every favorable slant. The parallel of 38°, or perhaps 40° N., once reached, bear to the eastward with the West wind, taking care, however, to cross the 130th meridian north of the parallel of San Francisco, as northerly winds in that locality are common.

§ 51. **Route from cape Horn to ports north of San Francisco.**—Follow the directions in section 50 to the point where the westerly winds are reached near 38° or 40° N., then lay a course to the northward of the port to be entered.

§ 52. **Route from Valparaiso to Callao and intermediate ports.**—The navigation of the Peruvian coast is very easy in summer; the land breezes are moderate; the weather, which is generally clear, allows the latitude to be observed nearly every day, and to recognize, by this means, the part of the coast opposite to which you may be. There is then no inconvenience in keeping a moderate distance off, so as to meet with fresh breezes, and thus shorten the passage.

The weather, which is often cloudy in winter, will not allow of observations to be taken every day, and you must then direct your course by your dead reckoning, or from the more remarkable objects lying on the coast. Those which are met with between the Quebrada Camarones and the valley of Tambo may be made out at a considable distance, so that when between these two remarkable points you may proceed by keeping 20 or 25 miles off the land. At this distance the sea breezes keep up through the greater part of the night.

The only objects at all remarkable that are to be met with between the valley of Tambo and that of Quilca, are the points of Islay and Cornejo, but these cannot be made out at more than 10 or 12 miles off, for when farther off they appear confounded with the high land of Peru. It seems that in this season you must continue to fix your position by the sight of the land, and so follow the coast at less than 10 or 12 miles distant; but as you then only find light airs, interrupted by calms, which may last for several days together, you run the risk of being carried too near the land by the heavy swell which is felt on all its extent. The depth off it is considerable, and the quality of the bottom very bad; it is only at the opening of the valleys that you can hope to find, at 2 or 3 miles from the shore, less than 30 fathoms water, over a bottom of mud or fine sand. The only advantage that will be gained by sailing so near the land will be to profit by the slightest breeze to get an anchorage, and to be seldom exposed to the chance of overrunning it; but these advantages, as will be seen, are not of a nature to compensate for the inconveniences, or rather the dangers, to which a ship is exposed.

It would, therefore, be better to sail farther off the land, keeping at 20 or 25 miles distance; as when between the Quebrada Camerones and the valley of Tambo, the swell is not felt at this distance, and the winds will be fresh; but the currents, which constantly run to NW., cause the reckoning to be very erroneous, and you may be carried to leeward of your port or the anchorage you may be seeking. Beyond this, this inconvenience is without danger, and cannot occasion more than a hindrance; for in returning to the required destination, sailing to the southward, you must run to the offing, bear up to the wind, and then approaching the land, reach the port which has been overrun. It is, notwithstanding, necessary, following the general rule, to make an exception, which in some circumstances may shorten the passage. We have said that the breeze was sometimes tolerably fresh, and that then the counter current, which runs to the south along the land, extends some miles in the offing; it is evident that it would be better to work in this counter current at all times when the force of the wind allows it, and you have not overrun your port more than 5 or 10 miles; but if you should have done so to a greater distance, it will be preferable to take directly the first course, and profit by this breeze to get away from the land.

It will be advantageous to maneuver thus every time you are on any portion of the coast which is described.

What has just been said relative to the mode of navigating and running along the coast of which we have just been speaking, applied to the portion comprised between the valleys of Quilca and Ocoña. But it is necessary to observe that the valley of Camana, which is as easy to be made out at 20 or 25 miles distance as that of Quilca, has the inconvenience, as well as the latter valley, of not being perfectly recognizable until it bears to the NE., when it is passed, and you cannot reach the anchorage on that tack.

In winter, as in summer, you must always be particular to approach the land to the south of the intended port, and then range the land at a short distance. The breezes being fresher in summer and the sea smoother the land is made more easily than in winter.

Captain Fitz-Roy says: "When going to the northward, along the coast of Chile, steer direct to the place, or as nearly so as is consistant with making use of the steady winds which prevail in the offing. Little difficulty is found in going to the northward along the coast of Peru; a fair offing is all that is required to insure any vessel making a certain port in a given number of days.

Captain Chardonneau gives the following instructions for the coast of Peru:

"As fogs are frequent, vessels should not get within 4 miles of the coast, yet in order to reach their destination easily they should not, on the other hand, run out to sea for more than 15 miles; that is, the prominent headlands should be kept within sight, as no confidence can be placed in the dead reckoning on account of the strong and variable currents."

§ 53. **Route from Valparaiso to San Francisco.**—After leaving Valparaiso a ship will generally find no difficulty in steering NW. and reaching the region of the SE. winds. After striking the trades the course should be shaped so as to cross the equator at the point mentioned in § 50.

§ 54. **Route from Callao to Paita and Guayaquil.**—As the wind in this locality always prevails from the southward and eastward the passage from Callao to Paita and Guayaquil may be made without any difficulty.

Vessels coming from Callao should steer to double Aguja point, which is long and level, terminated by a bluff about 160 feet high.

Vessels bound to Paita will find, after leaving Foca point, a line of cliffs, about 130 feet high, extending as far as Paita point, which is 9 miles distant, N. by E. Between these points, and 1½ miles from the coast, is a group of hills called the Silla, or Saddle of Paita, thus described by Capt. Basil Hall: "The Silla is sufficiently remarkable; it is high and peaked, forming three clusters of peaks, joined together at the base, the middle being the highest; the two northern ones are of a dark-brown color; the southern is the lowest and of a lighter brown. These peaks rise out of a level plain and are an excellent guide to vessels bound for the port of Paita from the southward."

Vessels bound to Guayaquil should make the land at Picos point, which is easily known by its sand downs.

A few miles farther north is the low wooded point of Malpelo.

§ 55. **Route from Callao to Panama.**—After leaving Callao and doubling the Pescadores and Pelado islands steer for Aguja point, where the wind is generally fresher than at other points on the coast. Keep about 20 or 25 miles from the coast between Aguja point and cape San Francisco, and from cape San Francisco as in § 48.

§ 56. **Route from Callao to Guatemala and Mexico.**—After leaving Callao and entering the SE. trades first steer for Aguja point. Then, if bound to Realejo or Istapa, shape the course so as to cross the equator between 85° and 88° W. But if the destination be Acapulco, San Blas, or Mazatlan, it is best to pass to the southward and westward of the Galapagos islands with the prevalent SE. winds. In this case the line should be crossed between the meridians of 96° and 100° W.

The last part of the voyage, from the equator to the port of destination, is the worst. Instructions were given in § 49 on the route from the line to the principal ports of Guatemala and Mexico, to which the reader should refer.

§ 57. **Route from Callao to San Francisco.**—The passage from Callao to the equator can be accomplished with a leading or fair wind. The line should be crossed west of the Galapagos islands, though it is not necessary to keep as far to the westward as advised in § 50.

In January, February, and March.—During these months the equator should be reached near 108° W., and 10° N. near 114° or 116° W. Up to this point vessels will have the SE. trades, and only 4 per cent. of calms north of the line. After striking the NE. trades, at about 10° N., steer a trifle free and cross 20° N. about 127° W., as farther to the eastward and near 120° W. the wind is sure to haul to the northward. Nothing will therefore be gained by hugging the wind as eventually more westing will result, and the voyage be lengthened.

The last part of the voyage is the same as that described in § 50.

In April, May, and June strike across the prevalent SE. trades and reach the equator between 108° and 113° W., and 10° N. at about 120° W.; thence continue according to the directions given in § 50.

In July, August, and September sailing vessels leaving Callao should follow the same route as vessels coming from cape Horn; that is, they should not cross the equator to the eastward of 125° W. By keeping on this route they will have steady SE. trades until they reach 10° N., which should be crossed at 130° W. The remainder of the passage should be made as described in § 50.

In October, November, and December cross the line near 108° W.; and 10° N. between 118° and 120° W., with steady SE. trades. After this keep a little free with the NE. wind. Ships generally run from one set of trades to the other without any intervening calm. This passage should also be finished according to the instructions given in § 50.

§ 58. **Route from Paita or Guayaquil to Panama.**—Same direction as in § 55.

§ 59. **Route from Paita or Guayaquil to San Francisco.**—Same direction as in § 57.

§ 60. **Route from Panama to Mexico.**—It is exceedingly difficult to determine which is the best route between Panama and the Mexican ports. Calms and light baffling airs often make the passage excessively long; and, coasters excepted, ships without steam should, if possible, avoid making this passage.

According to Fitz Roy's instructions vessels can only go up the coast by keeping near land, after doubling cape Mala, and by making use of the land and sea breezes. But the voyage should not be attempted at all, except by good ships with a large crew, unless the destination is one of the ports of Central America, and then only because it is the only one to take.

From December to April.—Commander James Wood says: "If bound to the westward during the season of northers, a great deal of time may be saved by keeping close inshore, and thus taking advantage of them; they will carry you as far as the gulf of Nicoya. When past the Morro Hermoso, 'papagayos' may be looked for, and with them a course should be steered for the gulf of Tehuantepec, when it will depend on the port to which you are bound, whether, after crossing the gulf by the aid of one of its gales, you should keep in or off shore. If bound for Acapulco keep in and beat up; but if bound to the westward you cannot do better than make a west course as nearly as the winds will allow you."

From May to October.—The passage to the westward from Panama during the rainy season is a most tedious affair; calms, squalls, contrary winds, and currents, a heavy swell and extreme heat, as well as an atmosphere loaded with moisture and rain, are the daily accompaniments. It often occurs that 20 miles of westing are not made in a week, and it is only by the industrious use of every squall and slant of wind that the passage can be made at all. Opinions are divided among the coasters as to the propriety of working to the southward, and trying to get rid of the bad weather, or beating up within a moderate distance of the land. Experience would lead one to prefer the latter, as the strong winds and frequent squalls, which so often occur near the land, sometimes allow a good long leg to be made to the northwestward, while, farther off, this advantage is sacrificed for only a shade finer weather.

§ 61. **Route from the Galapagos islands to cape San Lucas.**—The Galapagos islands are in the marginal eastern limit of the SE. trade. In January, February, and sometimes March, among the islands, calms and light airs last for long periods. The course is west until the trade is established and then steer along the coast, being careful not to get to the east of a line from the islands to cape San Lucas.

§ 62. **Route from Panama to Realejo, and from Realejo to Acapulco.**—(Captain Basil Hall's observations.) "On leaving Panama for Realejo, come out direct to the northwestward of the Pearl islands;

keep from 60 to 90 miles off the shore as far as cape Blanco (gulf of Nicoya); and on this passage advantage must be taken of every shift of wind to get to the northwestward. From cape Blanco hug the shore in order to take advantage of the northeasterly winds which prevail close in. If a papagayo (as the strong breeze out of that gulf is called) be met with the passage to Realejo becomes very short.

From Realejo to Acapulco keep at the distance of 60, or, at most, 90 miles from the coast.

If, when off the gulf of Tehuantepec, any of the hard breezes which go by that name should come off it is advisable, if sail can be carried, to ease the sheets off and run well to the westward, without seeking to make northing; westing being, at all stages of that passage, by far the most difficult to accomplish. On approaching Acapulco the shore should be got hold of, and the land and sea breezes turned to account.

This passage in summer is to be made by taking advantage of the difference in direction between the winds in the night and the winds in the day. During some months the land winds, it is said, come more off the land than at others, and that the sea breezes blow more directly on shore; but in March there is seldom found a greater difference than four points; and to profit essentially by this small change constant vigilance and activity are indispensable. The sea breeze sets in with very little variation as to time, about noon or a little before, and blows with more or less strength till the evening. It is usually freshest at two o'clock, gradually falls after four. and dies away with the sun. The land breeze is by no means so regular as to its periods or its force. Sometimes it comes off in the first watch, but rarely before midnight, and often not till the morning, and is then generally light and uncertain. The principal point to be attended to in this navigation is to have the ship so placed at the setting in of the sea breeze that she shall be able to make use of the whole of it on the port tack before closing too much with the land. If this be accomplished, which a little experience of the periods renders easy, the ship will be near the shore just as the sea breeze has ended, and then she will remain in the best situation to profit by the land wind when it comes, for it not only comes off earlier to a ship near the coast, but is stronger, and may always be taken advantage of to carry the ship off to the sea breeze station before noon the next day."

§ 63. **Route from Panama to San Francisco.**—(Maury's instructions.) The passage under canvas from Panama to California is one of the most tedious known to navigators.

From the bay of Panama make the best of your way south, keeping near 80° W., until you get between 5° N. and the equator. After crossing 5° N., make a SW. course if the winds allow; if the wind be SW., brace up on the starboard tack; but if it be SSW., stand West, if it be a good working breeze. But if it be light and baffling, with rain, know that you are in the doldrums, and the quickest way to clear them is by making all you can on a due South course.

From June to January.—Suppose that after crossing 5° N. you are to the west of 85° W. without having crossed the equator. Now, if the time of the year be in that half which embraces July and December the prevailing winds will be between SE. and South, inclusive, and the course is West as long as there is a breeze; as soon as the breeze dies and you begin to fight the baffling airs, conclude that you are in the vicinity of the doldrums that are often found here, either between the NE. and SE. trades, or between one of these trades and the system of southwardly monsoons that blow north of the line, and between the coast and the meridian of 95° W. These belts of doldrums lie east and west, and the shortest way to cross them is by a due North and South line. Having crossed 95° W., stand away to the northward and westward with a free wind, and after reaching 100° W., aim to pass some distance from Clipperton.

From January to June.—If the passage from Panama be attempted in January, February, March, April, May, or June, time will propably be saved by going south of the equator, for at this half of the year the NE. trades and the equatorial doldrums are often found between 0° and 5° N. Between the meridians of 80° and 85° W., in this part of the ocean, these winds and calms are found even in the months of July and August. The navigator should therefore run south of the Galapagos islands, and not cross the equator again to the northward before he reaches 105° W. Aim to cross 10° N. at 120° W., when the NE. trades will probably be found.

West of longitude 100° W., and between the parallels of 5° and 10° N., the winds in the months of November and December are variable between NE. and South, by way of East. In January, February, and March they are quite steady as NE. trades. In April they are variable. The doldrums are generally found between those parallels in this month. During the rest of the year the winds are all the time between SE. and SW.

It will be well to cross the parallel of 10° N. at least as far west as the meridians of 105° or 110° W. Here between the parallels 5° and 10° N. the winds in November are steady from SSE. and South. December, April, and May are the months for the doldrums in this part of the ocean. Having crossed the parallel of 10° N. between 105° and 110° W., the navigator is then in the fairway to California.

In making the west coasts of Mexico and the United States, the kelp is said to form an excellent landmark. This weed is very long, and grows in the rocks at the bottom. When, therefore, on approaching the coast, you come across lines or swaths of tangled kelp, its being tangled or matted is a sign that it is adrift. But when you come across it tailing out straight, it is then fast to the rocks at the bottom, and it is dangerous to get among it.

Auxiliary steamers should steam whenever necessary after leaving Panama, and aim to cross the line near 85° W. Thence the route lies either to northward or southward of the Galapagos, according to the season. The remainder of the voyage can be easily made under canvas."

§ 64. **Route from Mexico to San Francisco.**—(Captains Osborn and Wood.) A vessel sailing from one of the ports of Mexico or Guatemala, should gain the NE. trades as soon as possible. When they are reached keep the ship a little free on a NNW. course, until the West winds are found to northward of the parallel of San Francisco.

In January, February, and March.—Vessels leaving Mazatlan during these months will have quite fresh winds varying between North and West; with these they can easily pass to the northward of the Revilla Gigedo islands.

Ships leaving San Blas can also fetch to the northward of these islands by making up the coast on the land tack, if necessary. After they have crossed the meridian of 120° W. between 20° and 24° N., they will enter the region of steady NE. trades.

During the same season, vessels leaving Acapulco will have at first 6 per cent. of calms and variable NE. and NW. winds. They should make as much to the westward as possible, and will meet the NE. trades beyond and near 110° W. After this they should run a little free on the starboard tack and end the voyage as already described.

Ships leaving Istapa and Realejo should steer as nearly as possible SW., with the prevalent NE. wind, and thus reach 8° or 7° N. near 93° W. Thence the course should be due West to 108° W., the wind being quite fresh from SE. After crossing this meridian vessels should begin to bear to the northward and cross 10° N. near 111° or 112° W. The NE. trades will be found in this locality.

In April, May, and June.—Ships coming from San Blas or Mazatlan during these months will do well to beat up against the NW. winds, as advised by Sherard Osborn, as far as cape San Lucas. They should then keep close to the wind, which will be variable and from North to West, mainly from NW., standing well out to sea on the starboard tack. Nothing will be gained by crossing 120° W. to the northward of 20° N., as beyond this parallel the wind hauls more to North, while to the southward it inclines toward NE. In all cases the wind will become more and more favorable to the westward, enabling vessels to gradually bear away to the northward for the region of West winds.

Vessels leaving Acapulco at this season are liable to be detained by numerous calms and NW. to NE. winds. They should therefore run to the southward and westward for the SE. trades, near 10° or

8° N. Good way may be made to the westward, near these parallels and to 118° W.; when, bear to the northward and cross 10° N. near 120° W. Here vessels usually run into the trades without meeting any calms.

The course from Istapa or Realejo to 8° or 7° N. and 92° W. is SSW. or South. Vessels will here strike the southerly or southeasterly wind and then should steer due West, the SE. wind freshening as they go to the westward. Near 118° W. they should begin to make northing, probably meeting the NE. trades at 10° N. and 120° W.

In July, August, and September.—Ships sailing from Mazatlan or San Blas, during these months, should take the route given for the preceding season; the circumstances attending the passage will, however, be more unfavorable, the calms more numerous, and the baffling airs from NW. more frequent. Vessels with steam power will, therefore, have a great advantage, as they can steam to cape San Lucas.

During this season it will be greatly to the advantage of sailing vessels leaving Acapulco, Istapa, and Realejo, to make for the SE. trades, to the southward of 10° N. Steamers, while they should take advantage of every puff of wind that may help them on their course to West or NW., should keep up steam until they reach the NE. trades.

In October, November, and December.—Ships starting for Mazatlan or San Blas during this season will find almost the same weather as that for the preceding three months; it will, however, be a little better. Those leaving Acapulco should steer to the westward, as in January, February, and March. They will first have light variable winds from NE. to NW., and be liable to about 9 per cent. of calms. The NE. trades blow beyond 110° W., and become steadier and steadier to the westward of that meridian. Ships leaving Istapa or Realejo should first make to the southward and westward in search of the SE. trades to the southward of 10° N. From the beginning of the passage they will generally have gentle, though variable, winds to help them toward the trade-wind region. After meeting the SE. wind, good way can be made to the west on the parallel of 8° N. Vessels should commence to bear to the northward at 113° W., and cross 10° N. between 116° and 118° W. After this the NE. trades will be found, when the ship can be hauled up on the starboard tack.

§ 65. **Routes from San Francisco to ports north.**—In the last part of § 24 instructions relating to the prevailing winds between San Francisco and Vancouver will be found.

From November to April, or during the bad season, the passage should commence by putting well out to sea. This will generally be easy to do, as the wind is oftenest from NW. When far enough from land to have nothing to fear from SW. or NW. squalls, make as much to the north as possible. North of the parallel of cape Mendocino the SW. winds prevail, enabling vessels to finish the voyage without difficulty.

From April to November, or during the good season, the wind almost invariably blows from the northward, between NW. and NE. NW. is the favorite quarter, though SW. and SE. winds have been known in this locality. After leaving San Francisco run about 100 or 150 miles off shore, and then make to the northward, profiting by every shift in the wind, and always standing on the most favorable tack.

CHAPTER II.

ROUTES FROM NORTH TO SOUTH ON THE WESTERN COAST OF AMERICA.

§ 66. **Routes from northern ports to San Francisco, Mexico, Panama, South America, or the Horn.**—In § 24 will be found the winds to be expected on the coast.

If bound to San Francisco keep between 50 and 100 miles off shore to obtain the benefit of the current and to avoid fogs. Take advantage of either tack upon which the most latitude may be made, always making the land to the northward of the port in summer, and to the southward in the winter season.

Use every opportunity to observe for latitude and longitude, so as to know the vessel's position up to the latest moment, as fogs and haze, preventing observations, prevail near the land. Allow generally for a southerly set of ½ mile per hour, until within about 50 miles of land; after which, at times, it is not appreciable. With these precautions vessels may steer boldly on, shaping a course for the south Farallon, an islet about 250 feet high and a mile long, having 14 fathoms of water, and a good holding ground on the SE. side.

From November to April, or during the bad season, vessels are liable to have head winds from SW. between Vancouver and the parallel of cape Mendocino. However, these winds are variable, blowing quite often from NW.; the currents, moreover, are generally favorable, and consequently there will be no serious difficulty to overcome. To the southward of 40° N. the NW. winds will become more frequent, and consequently the weather more propitious.

From April to November, or during the good season, the NW. wind prevails from Vancouver to Monterey, and even beyond this point. This is therefore an easy passage to be made at this season as the current is also favorable. The wind frequently blows from SW. during the morning and from NW. during the afternoon.

After reaching the latitude of San Francisco if bound to Mexican ports follow directions in § 67.

For Panama, § 68.

For South American ports north of Valparaiso, § 69.

For Valparaiso and ports south, § 71.

For the Horn, § 72.

§ 67. **Route from San Francisco to Mexico.**—Ships leaving San Francisco for Mazatlan or San Blas will, at all seasons, have the wind and current favorable. The former is generally from the northward and westward; and from December to June is well settled as far as the port of destination.

To the southward of 30° N. the winds usually become lighter from July to December. During this season the chances of becoming becalmed off the coast of Mexico are greater. It will be a good plan to run in close to cape San Lucas, and to be careful that the vessel is not set to leeward of her port by the current.

Vessels bound to Acapulco will experience the same wind and weather. Beyond cape Corrientes they are liable to be delayed by calms, particularly between June and October. During these months, which correspond to the bad season, the winds usually blow from NW. (§ 24), but they are generally so light and last for such a short time, that patience only is necessary. Auxiliary steamers will, therefore, have an immense advantage during the latter part of this voyage, as well as on all the coast of Mexico and Colombia. During the winter, or the good season, the chances of calms are less, and the descent of the coast can be made with more facility from cape Corrientes to Acapulco, or even to Istapa and Realejo.

§ 68. **Route from San Francisco to Panama.**—Maury says: "Vessels out of San Francisco, intending to touch at Panama or any of the ports south, should steer straight for the line somewhere about 104° W., and stand on south until they can, with the SE. trades, run in on the starboard tack for the land."

This off-shore route is undoubtedly the best for sailing vessels, at least during the rainy season off the coast of Mexico (from May to October). Vessels keeping near the coast at this time of the year may find themselves, at any moment, becalmed or headed off by the SE. winds, which are quite frequent. Auxiliary steamers can, if need be, use their engines and make good headway by crossing 20° N. near 108° or 109° W.; and 10° N. at about 98° W. To the southward of 10° N. they will find quite settled winds from South and SE., which, at times, shift to SW., to the eastward of 88° W.

From May to October, as has been already said, sailing vessels leaving San Francisco should stand well out to sea with the favorable NW. winds. They should steer so as to cross 20° N. near 118° or 120° W.; then head South or SSE., with the NE. or NW. winds. If these grow light it should be remembered that the wind is more settled to the westward, and that the chance of meeting calms is greater near the coast. To the southward of 10° N. settled SE. trades will be found. Here haul up on the port tack, and stand on until sure of reaching Panama, on the starboard tack, when go about. The Galapagos islands can be passed to the northward, and 90° W. near 4° N. To the eastward of this proposed point of crossing the winds will generally be found to be settled from SE. and South; however, they often veer as far as SW.

From November to April.—The dry season on the coast of Mexico lasts from November to April, when vessels should also follow the offshore route; they should not, however, go quite so far to the westward at this season, though it will probably be found necessary to make a little more southing. From San Francisco to 20° N. the winds are generally favorable from NE. to NW.; and this route passes some distance to the westward of the Revilla Gigedo islands. Below 20° N. the NE. trades blow with such regularity that 10° N. can be crossed at 110° W. As soon as the wind begins to grow light steer South for the SE. trades; with which stand on, on the port tack until certain that the vessel will fetch to southward of the Galapagos on the starboard tack. The starboard tack will bring the ship near cape San Francisco, and the last part of the voyage will be identical with that described in § 48.

Auxiliary steamers should cross 20° N. at 109° or 110° W., and go down the Mexican coast with the prevalent NW. winds, steaming when becalmed. It will be to their advantage to cross 10° N. in the neighborhood of 89° or 91° W.; but they will afterward encounter SE. and South winds; these being often variable and light, steam will have to be used to reach Panama" (§ 73).

§ 69. **Route from San Francisco to Callao.**—*November to June—The Western route.*—(Maury.) Steer the same course from California as if bound around the Horn until the SE. trades and calms of Capricorn are passed through. When you get your offing from the 'heads,' steer South, aiming to cross the line not to the east of 115° W., for the rule is the farther east the harder it is to cross the equatorial doldrums in the Pacific, as well as it is in the Atlantic.

When you get the SE. trades, crack on with topmast studding sail set, until you get the West winds on the polar side of the calms of Capricorn. Now turn sharp off from the route around cape Horn, and run east until you bring your port to bear to the northward of NE., when you may 'stick her away.' By this rule, the Chincha-bound navigator may sometimes, before he gets these westerly winds, find himself as far south as 40° or 45°, and as far west as 120° or 125°. Let him not fear, but stand on until he gets the winds that will enable him to steer East, or until he intercepts the route from Australia to Callao, when he may, without fear of not fetching, take that.

June to November.—In the summer and fall of the northern hemisphere the calm belt of Capricorn will be cleared generally on the equatorial side of the parallel of 30° S.; at the other seasons you will have frequently to go six or eight degrees farther.

On this voyage navigators, as soon as they leave the SE. trades, are often tempted by puffs and spirts of westerly winds to stand east; and thus time is lost by running east with a 4 or 5 knot breeze in the calm belt of Capricorn. They should stand south until they clear it, preferring, as a rule, to take the chances of better winds and the certainty—which is some compensation—of shorter degrees of longitude beyond.

Auxiliary steamers should follow the route given in § 68, that is, keep nearer to the Mexican coast, and make the coast of South America near cape San Francisco.

In January, 30° S. will generally be made, on the port tack, between 118° and 122° W., then run to the east on the parallel 32° S. until near 98° W.

In February, March, and April, cross 30° S. near 118° W., and then steer to the eastward on 35° or 36° S.

In May, cross 30° S. in the neighborhood of 123° W., and make to the eastward between 32° and 33° S.

In June, 30° S. can be crossed between 123° and 128° W.; the West winds prevail at 35° S.

In July, cross 30° S. between 118° and 123° W.; and as the West winds are to be found a little farther north, run down the easting between 33° and 34° S.

In August, the SE. trades will be very variable, and 30° S. should be crossed between 118° and 128° W., more or less to the east or west, as circumstances allow. The easting should be made on the parallel of 32°.

In September, 30° S. cannot be crossed to the eastward of 128° W.; the easting should be made on 33° S., or near that parallel.

In October, 30° S. can be crossed a little farther to the eastward than during the preceding month, and the easting made on 32° S.

In November, after having crossed the line near 113° W., and 30° S. between 118° and 122° W., steer to the eastward near 33° S.

In December, cross 30° S. near 118° W., then follow 32° S. to the eastward.

While the western route is the better during the months from November to July, the eastern route in July, August, September, and October is, for many reasons, quicker; therefore, leaving San Francisco for Callao in the months of August, September, and October it is advisable to take the inner or eastern passage, that is, being in the longitude of 110° W., latitude 8° N., steer along the equator by the wind, passing either side, or between the Galapagos islands, as the wind will permit.

Auxiliary steamers taking the eastern route will be enabled to cross 10° N. between 89° and 91° W. They will then experience variable winds till they reach cape San Francisco. These winds blow quite often from South and SE., with 5 per cent. of chances of calms.

Steam will have to be used about half the time in this locality. The passage from cape San Francisco to Callao will be tedious, as both wind and current are from the southward. If this part of the voyage be made under canvas it will last at least 25 days.

§ 70. **Route from San Francisco to the intermediate ports.**—This voyage should be made in exactly the same manner as that described in § 69, western route; that is, keep always to the west, or SE. trade-wind route. Stick to the port tack until you strike the West winds to the southward of 30° S. Afterwards the course should be to the east, until the port of destination bears to the north of NE. Thus, if the port of destination be Iquique or Arica, 92° W. should be reached before bearing away to the northward.

§ 71. **Route from San Francisco to Valparaiso.**—According to Maury, the route to Callao is longer than that to Valparaiso; owing to the fact that sailing vessels have to make the parallel of Valparaiso before striking to the northward for Callao, consequently the mean of the voyages from California to Peru being about 56 days, vessels can count on a mean passage of about 50 or 55 days from California to Valparaiso.

In § 69 all the necessary instructions relating to this passage are given.

§ 72. **Route from San Francisco to cape Horn.**—Nothing especial is to be added to what has been stated in the preceding sections, particularly in § 69.

After standing well full on the port tack, through the SE. trades, steer South until the region of West, NW., and SW. winds is reached, or in other words until between 35° and 40° S. Then bear away around cape Horn on a great circle route, as nearly as the wind will permit.

Information relating to icebergs will be found in § 43.

§ 73. **Route from Mexico to Panama.**—(Observations of Captain Basil Hall.) "The passages from Mexico to Panama are always easy. In the period called here summer, from December to May, a distance of 90 to 150 miles from the coast insures a fair wind all the way. In winter it is advisable to keep still farther off, say 300 miles, to avoid the calms, and the incessant rains, squalls, and lightnings, which everywhere prevail on the coast at this season. During winter all ports on this coast should be made to the southward and eastward, as the currents at this time of the year set from that quarter."

Captain Hall's instructions seem to be completely indorsed by a study of the prevailing winds in these quarters.

From December to May vessels can easily keep along the coast as far as 10° N., or even all the way to Panama, the wind generally varying between NE. and NW., but there is a chance of meeting southeasterly and southerly winds in the offing, south of the 10th parallel.

After May calms will render the passage particularly difficult, and it will be advisable to keep farther from the coast. Vessels coming from Mazatlan or San Blas should cross 12° or 13° N. near 100° W.; then 10° N. at 92° or 93° W.

From May to October the direction of the wind is generally favorable as far as 103° W.; prevailing SE. winds will then be found, becoming steadier and stronger to the southward and eastward of that meridian. The last part of the passage will ordinarily be long and irksome. Vessels leaving Acapulco during this season should at first make as much to the southward as possible, and not attempt to work to the eastward until they are in the neighborhood of 12° S."

We will finish with a quotation from Fitz Roy:

Panama bay.—"Vessels bound to Panama from northward should make the island of Hicaron, which lies about 50 miles westward of Mariato point, and from this endeavor to keep under the land as far as cape Mala. If unable to do this they should push across for the east side of the bay, when the current will be found in their favor. On getting eastward of cape Mala the safest plan is to shape a course for Galera island, and to use the eastern passage. At the same time, if tempted up the gulf by a fair wind, vessels should endeavor to get on the western coast of the Pearl islands."

§ 74. **Route from Mexico to Guayaquil.**—The principal points of this route, which is usually long and tedious, will be found in § 69, under the head of the eastern route from California to Callao; also in § 73.

The best manner of approaching Guayaquil (Findley):

Coming from the northward Santa Clara island may be made, which is visible about 16 miles, and at first appears like three hummocks; and Zampo Palo, the high range on Puna island, will generally be seen at the same time.

Santa Clara should not be approached nearer than 2 miles, or within the depth of 12 fathoms, the best track being about 5 miles to the southward of it, in from 20 to 15 fathoms of water, whence NE. for 25 miles will lead toward Arenas point. (See § 54.)

§ 75. **Route from Mexico to Callao.**—Auxiliary steamers should always approach the land near cape San Francisco. Their steam power will help them both in the first part of the voyage and while beating up to Callao beyond capes San Francisco and Santa Elena.

Sailing vessels and auxiliary steamers desiring to economize coal will find it generally advantageous to take the west route.

The west route seems to be undeniably the better for vessels leaving San Blas, Mazatlan, or Acapulco. If the point of departure is farther south, Istapa or Realejo for instance, there may be some doubt as to which is the better route; but even then it would seem that the westerly passage is the one to be preferred. The SE. trades will be found to the southward of 10° S., when haul up a little free on the port tack, and pass a trifle west of the Galapagos islands. (See §§ 68 and 69.)

If it is required to return direct from San Blas to Callao a course must be shaped so as to pass between the island of Cocos and the

Galapagos, and to the southeastward, till the land be made a little to the southward of the equator, between cape San Lorenzo and cape Santa Elena. Then work along shore as far as Aguja point, in latitude 6° S., after which work due South, on the meridian of that point as far as 11° 30′ S., and then stretch inshore.

Vessels deciding to cross the SE. trades should, however, run boldly through the region of SE. winds, no matter how much they may at first be set to the westward. Those, on the contrary, deciding to make the passage along the coast, should, from January to April, keep within 15 miles of land, and take advantage of the Mexican current, which sets ESE. with a speed of 1½ knots per hour.

Vessels taking the inshore route can hardly expect to make the passage from San José de Guatemala to cape Blanco in less than fifteen days; and the whole voyage to Callao in less than thirty-five days.

§ 76. **Route from Mexico to ports south of Callao, Valparaiso, and cape Horn.**—It was stated in the preceding section that the western route seems to be the better for sailing vessels making passage from Mexico to Callao. We have also stated that the eastern route has its partisans, and that vessels leaving the southern ports such as Istapa or Realejo, may have quite a short passage.

But when vessels, bound to a port south of Callao, leave the Mexican coast, it seems impossible that they should prefer any other to the western route. Therefore ships leaving San Blas, Mazatlan, or Acapulco should profit by every breeze that will set them to the southward, always choosing, if the wind comes out ahead, that tack by which they can make SW. or SSW. in preference to the one which will take them to the southward and eastward. Vessels leaving Realejo should steer SSW. as nearly as possible. By following this advice they will find the SE. trades near 10° N. No other recommendation is needed, except to keep "rap full" on the port tack, and never hug the wind. If bound to one of the intermediate ports do not go about in the trades until your port bears north of NE. But if the destination be Valparaiso, keep on the port tack to the region of prevalent westerly winds, near 32° or 34° S. Ships bound around the Horn should steer South until they have settled and steady West winds, when they can gradually bear away to the eastward.

§ 77. **Route from Panama to Guayaquil, Paita, and Callao.**—It will be to the advantage of ships leaving Panama for Guayaquil to keep close to the land. If they are bound farther down the coast, they should, after doubling cape Blanco, follow the instructions given in § 79.

§ 78. **Routes from Panama to ports south of Callao, Valparaiso, and cape Horn.**—Make to the southward as much as possible, taking advantage of every favoring breeze, and thus reach the SE. trades by the most direct route. Below 5° N., and especially to the westward of 80° W., settled southerly winds will be found, ranging between the SE. and SW. points of the compass.

The passage may be made along the coast to cape San Francisco, or even to cape Blanco, though if the wind shows a tendency to come from the southward and eastward, it is well to stand off shore on the port tack before reaching San Francisco. If bound to any of the intermediate ports, the inshore route is preferable, as a long stretch on the port tack is liable to set vessels too far to the southward and westward of their destination. We again repeat the rule, that vessels should never go about in the SE. trades until the port of destination bears north of NE.

§ 79. **Route from Guayaquil and Paita to Callao.**—Fitz Roy gives the following instructions on this route:

"On leaving Guayaquil or Paita, if bound to Callao, work close inshore to about the islands of Lobos de Afuera. Endeavor always to be in with the land soon after the sun has set, so that advantage may be taken of the land wind, which, however light, usually begins about that time; this will frequently enable a ship to make her way along shore throughout the night, and will place her in a good situation for the first of the sea breeze.

After passing the above mentioned islands, it would be advisable to work upon their meridian until the latitude of Callao is approached; then stand in, and if you do not make it, work up along shore, as above directed, remembering that the wind hauls to the eastward on leaving the coast. Some people attempt to make this passage by standing off for several days, hoping to fetch in well on the other tack; but this will generally be found a fruitless effort, owing to a northerly current which is often found on approaching the equator. The mean passage for weatherly vessels is fifteen or twenty days from Guayaquil to Callao.

To work along shore with effect the land must be kept well aboard and constant vigilance be bestowed upon the navigation, otherwise a ship will make little progress.

On account of the land trending so much to the eastward, if you stand twelve hours off shore and twelve hours inshore at the same rate of sailing, and have gained any southing of consequence, you will still be a considerable distance off shore when your twelve hours are completed standing in; and it will be found in general most advisable to stand off only about ten hours and in for fourteen hours; as, even if you get inshore rather too soon, you can, by making a short tack or two, be sure of being near the shore at sunset, when you may expect the wind rather to favor you for gaining southing with your port tack on board.

On the off-shore tack you will generally find that the vessel comes up more and more as you stand off, but do not let this persuade you to stand off too far, even should the vessel head up South or S. by E. by compass, as you will lose more on the inshore tack, when you must be headed off in proportion as you have headed up on the offshore tack. The inspection of the chart will at once convince any person of this fact, even if there is no northerly current. Of course, bringing that directly on or abaft a vessel's beam must sag her to leeward."

On the coast of Peru the water is frequently of a dirty-brown color, and sometimes quite red, as if mingled with blood.

§ 80. **Route from Guayaquil and Paita to ports south of Callao.**—Vessels should strike through the trades on the port tack, as if bound to Valparaiso, and go about when their port bears to northward of NE. They will consequently leave the trades, and make their easting near 30° or 32° S.

§ 81. **Route from Guayaquil and Paita to Valparaiso and cape Horn.**—Fitz Roy's instructions on this route may be condensed as follows:

"Sailing vessels bound from Guayaquil to Valparaiso should stretch out to sea, crossing the Peruvian current before passing the meridian of 92° W. From this they should push to southward, not caring about being driven to the westward if southing can be made, as they will have no difficulty in making their easting on the parallel of Valparaiso. This passage is generally made in thirty-seven days."

Detailed instructions will be found in § 69 on the proper manner of steering through the trades and prevalent westerly winds in order to reach Valparaiso or cape Horn.

§ 82. **Route from Callao to the Chincha islands.**—We will cite the instructions on this passage given by Captain Chardonneau in his work on the coast of Peru:

"Going from Callao to the Chincha islands or Pisco it is best to keep at a distance of from 25 to 40 miles from the coast until SW. of Cerro Azul. Then stand in to within 10 miles of the land, as, from this point to Pisco there is nearly always a light northerly breeze during the morning.

It frequently happens that, after finding a calm in the morning abreast of Cerro Azul, the ship will at night be anchored off Pisco. The current sets steadily to WNW. in this locality.

It is advisable to keep away from the shore during the night and near it during the day until beyond the 13th degree of latitude, then work along at a distance of 4 or 5 miles from the land."

Captain Harvey's advice for the autumn months is to run twenty-six hours to seaward and twenty-two to landward, thus being, at the end of forty-eight hours, to windward of San Gallan.

Fitz-Roy says: "Approach land during the afternoon, and thus be in readiness to take the off-shore tack at sunset, would seem to be the best. Stand on this tack until the morning at 9 o'clock, when go about.

By proceeding in this manner navigators need not fear (if the wind haul ahead) that they will be as far from the Chinchas at the end of twenty-six hours as they were at starting."

§ 83. **Route from Callao to the ports between Callao and Valparaiso.**—After stating that vessels bound to Valparaiso should run off shore, Fitz Roy remarks:

"All these, except Coquimbo, lie considerably within the trade wind, and must be attained through that medium alone. A very dull sailer might indeed do better by running through the trade, and making southing in the offing, so as to return to the northward along the coast, than by attempting to work to windward against a trade wind, which never varies more than a few points.

It may be recommended to work along shore, in a good sailer, as far as the island of San Gallan, whence the coast trends more to the eastward, so that a long leg and a short one may be made (with the land just in sight) to Arica, or to any of the ports between it and Pisco.

From Arica, the coast being nearly north and south, vessels bound to the southward should make an offing of not more than 45 or 60 miles, so as to insure keeping the sea breeze, and work upon that meridian till in the parallel of the place to which they are bound, but on no account is it advisable to make a long stretch off; for as the limit of the trade wind is approached it gradually hauls to the eastward, and great difficulty will be found in even fetching the port from which they started.

As the weather along the south coast of Peru is invariably fine, ships are not otherwise incommoded at the various anchorages than by a high swell, which always rolls in at the full and change of the moon.

The parallel of their port once reached, vessels should run in for the land, being careful not to lose anything that they have made in latitude. If the landfall be made a few miles to windward the anchorage can always be reached, even during a calm, as the current and 'catspaws' are sufficient for working up to the port."

§ 84. **Route from Callao to Valparaiso.**—Fitz Roy's instructions: "For a sailing vessel bound from Callao to Valparaiso, there is no question but that by running off with a full sail the passage will be made in much less time than by working inshore, for she may run quite through the trade, and fall in with the westerly winds which are always found beyond it. The average passage is about three weeks. Fast schooners have made it in much less time; and there is an instance of two men-of-war sailing in company, having gone from, Callao to Valparaiso, remained there two days, and re-anchored at Callao on the twenty-first day."

Vessels going to Valparaiso should head for the island of Juan Fernandez as soon as they strike the variable winds, and, passing to the northward of the island and in sight of it, stand to the eastward until they sight Curaumilla point, if it is the summer season. But in winter (from May to August) steer for Valparaiso, taking care not to enter the port if the wind be from the north and the barometer be falling, for the anchorage is then dangerous, and it is preferable to lie to outside until the wind comes out from the west, when there will be no risk.

We will complete these instructions by giving, for each month, the principal crossings on the route from Callao to Valparaiso. By first tracing on the chart the indicated route, the navigator will be enabled to make the passage under approximative mean conditions. Still it should be understood that the route may be altered if the wind is contrary. As a general rule the ships which keep a little free are the ones which make the quickest passages; consequently it may become necessary to make a longer circuit than that given, and yet have a quick voyage.

In January, cross 15° S. near 79° W.; 20° S. near 81°; 25° S. near 82°; 31° S. near 82°; 32°30′ S. near 80° W.; then head for Valparaiso.

In February the port tack carries vessels to 25° S. and 83° W.; beyond this parallel the chances will vary, and they may find winds from South and SW.; 80° W. should generally be crossed between 32° and 33° S.

In March, 20° S. can generally be crossed near 81° W.; 30° S. near 84°; here the winds are from SE. to SW., and haul to the westward as the ship goes south. The parallel of 32° 30′ S. should be crossed near 80° W.

In April, cross 20° S. at about 81° W.; vessels can often reach 25° S. between 81° and 82° W.; 30° S., near 81° W.; 31° or 32° S., near 80° W.; and thence steer for their port.

In May, cross 20° S. at 81° W.; 25° and 30° S. at 82° W., and then make for Valparaiso.

In June, cross 20° S. at 81° W.; 25° S. at 82°; 30° S. between 80° and 81° W.; and then shape the course so as to make the parallel of Valparaiso near 75° W.

In July vessels will often be able to cross 20° and 25° S. at 81° W.; as the northerly winds are more frequent than during the preceding month they may fetch 27° 30′ S. at 79° W.; 30° S. at 77° W.; sailing directly for their port from this point.

In August, cross 15° S. in the neighborhood of 80° W.; 20° and 30° S. near 82° W.; 32° S. at 80°; and 32° 30′ S. at 75° W.

In September, cross 20° S. a little to the eastward of 81° W.; 25° and 30° S. between 81° and 82° W. and 32° S. at 79° W.

In October, cross 25° S. between 82° and 83° W.; beyond 30° or 31° S. a fair or leading wind will generally be found.

In November, cross 20° S. near 82° W.; 25° S., between 82° and 83°; and attempt to reach 30° S. near 80° W.

In December, 15° S. should be crossed at 80° W.; 20° S. at 82°; 25° S. at 84°; from this parallel to 30° S. the wind varies from SW. to ESE.; beyond 30° S. the direction of the wind is favorable for running down the easting.

§ 85. **Route from Callao to cape Horn.**—We have seen in the preceding section that ships leaving Callao for Valparaiso should keep a good full while passing through the SE. trades. This recommendation is just as important for ships bound around cape Horn. In this passage the region of westerly winds should be reached as soon as possible; no matter if the ship be carried very much to the westward in search of them. In short, the farther the ship crosses the parallel of 35° S. to the westward, the more favorable will be her position for doubling the cape with the NW. and SW. winds.

The great circle route is the best for doubling the cape.

A very good point to cross 30° and 35° S., is between 88° and 93° W.

§ 86. **Route from ports south of Callao to Valparaiso and cape Horn.**—(Fitz-Roy.) If bound to the southward steer direct for the place, if fortunate to have a wind which admits of it; but if not, stand out to sea by the wind, keeping every sail clean full, the object being to get through the adverse southerly winds as soon as possible, and to reach a latitude from which the ship will be sure of reaching her port on a direct course.

After leaving the SE. ports it will be still more to the advantage of ships bound to cape Horn to keep a "clean full" while making passage through the zone of southerly winds; in fact, they should steer a trifle freer than if bound to Valparaiso. It is probably best to cross 35° S. near 83° W., or even farther to the westward; and it can be generally stated that the farther 35° S. is crossed to the westward, the sooner the cape will be doubled. The length of the route will certainly be compensated for by the increase of speed, caused by keeping away, both in the trades and in the belt of westerly winds.

§ 87. **Route from Valparaiso to cape Horn.**—After leaving Valparaiso southerly winds will be encountered, except during the rainy season, when they are interrupted by northers.

It will therefore be easy for ships to make to the westward as far as Juan Fernandez.

As a general rule 35° S. should not be crossed at less than 80° or 82° W. It will be advantageous, as stated in the foregoing section, to cross this parallel as far to the westward as possible, that every advantage may be taken of the prevalent West winds, which haul to northward and to southward as far as 40° or 42° S.

In January and February, cross 35° S. at 82° W.; 40° S., when possible, between 80° and 85° W.; 50° S. at 81° or 82° W.

In March, cross 35° S. at 80° or 80° 30′ W. Aim to cross 40° between 80° and 83° W.; after which bear to the southward.

In April, May, and June, vessels are sufficiently far to the westward if they cross 35° S. between 78° and 80° W.; and 40° S. between 80° and 83° W.

In July and August, cross 35° S. between 81° and 82° W.; 40° S. between 82° and 83° W.

In September, October, November, and December, cross 35 °S. as far as possible to the westward. Thus, if it can be done, the parallels of 35° and 37° S. should be crossed between 82° and 85° W. The south winds at this season prevail as far as 40° or 42° S. The western route is therefore much the better.

The crossings just indicated for the different seasons show approximately the route which the winds allow. Sailing vessels should keep still farther to the westward if the wind permits. Auxiliary steamers need not, of course, make such a long circuit. They can head, for example, for 35° S. near 78° W.; and 40° S. near 80° W., using steam if necessary.

§ 88. **Route from Valparaiso to Concepcion.**—The prevalent winds along this coast are from the southward; it is necessary to take advantage of every slant that will allow of southing being made; but a passage may always be made to the southward, for the winds are seldom steady for twelve hours, and by taking care to profit by every change, southing must be made.

The passage from Valparaiso to Concepcion is generally made in ten days, which is also the usual time required for a passage to Callao. The distance, however, in the first case is 200 miles, and in the latter, 1,320 miles—a circumstance which points out very decidedly the direction of the prevalent winds.

Between Juan Fernandez and the coast of Chile it often happens that the wind prevails from SW. near the coast and from SE. farther out; or vice versa. Thus it is sometimes very difficult, after having made a great deal of latitude, to run down the longitude. By tacking under the land the passage will generally be shortened; the time from Valparaiso to Concepcion being only from four to eight days by the coast route; while it is from ten to fifteen days by the off shore route.

While beating up the coast the temperature of the water will show whether or not the ship is close to land, as the sea is colder near shore. According to M. Fleuriot de Langle, vessels bound to Valdivia or the Chiloé islands, and those bound around the cape, should keep on the port tack until they sight Juan Fernandez; they will usually make this island in three days. As the land is high, be careful not to approach too close to leeward, as ships are apt to lose the wind.

CHAPTER III.

ROUTES FROM THE WESTERN COAST OF AMERICA ACROSS THE PACIFIC.

§ 89. **Route from Valparaiso or Callao to Australia** (by the trades).—Vessels bound to Australia from the coast of Chile or Peru should first strike for the SE. trade region. Those leaving Valparaiso will therefore steer immediately NNW. or NW.; while those starting from Callao should head West. The settled SE. trades being once found, the passage to the Marquesas islands is quickly made.

Fatu Hiva, or Magdalena island, is a good land fall, and is 8 miles long north and south, and 4 miles broad. The land is high, with a peak rising 3,675 feet.

Between the coast of America and the Marquesas the wind will become steadier and haul more and more to the eastward as the ship goes to the westward.

Beyond the Marquesas constant trades can be relied upon, particularly from July to October; but they will not be so fresh or steady during the rest of the year. During the spring months. and after the sun has passed the summer solstice of the northern hemisphere, the voyage can be made to the northward of the Samoa group; passing close and to the southward of Uvea island, to the westward of the Fijis, the tropic can be crossed a little west of the meridian of the Isle of Pines. During the rest of the year, from November to June, steer direct from Fatu Hiva to Tongatabu and thence so as to cross the tropic near the same meridian, 166° E.

For further instructions on this route see §§ 133 and 139.

Auxiliary steamers starting from Valparaiso can shorten this passage by passing the Paumotu islands to the southward or by sailing through the group on the 20th parallel, pass the tropic near 98° W. and 20° S at 118° W. After reaching about 141° W., they can leave 20° S. and steer so as to intersect the parallel of Tahiti near 158° W. They can then pass between Samoa and the Tongas. The last part of the passage is similar to that already given. But we think that it will be advantageous for sailing vessels to keep to the route already indicated, especially from March to October; that is, to sight Fatu Hiva and pass to the northward and clear of the Paumotus. It often happens that calms or westerly breezes are found south of the Paumotus; though that, of course, will be no inconvenience if steam power is available.

§ 90. **Route from Valparaiso or Callao to the Indian ocean, Saigon, Batavia, Melbourne, etc.**—This passage can be made in two ways, by the trades and by the Cape Horn route:

These two routes are so different that it is difficult to decide which is the better. To make a choice between the two, one should take into account the qualities of the ship; the importance attached to making a passage more or less rapid, no matter what it may cost; the season of the year, etc.

The Trade Wind route will be less boisterous, but even this is often dangerous; in certain cases it will be sensibly longer. The Cape Horn route is severe and generally quicker, passing through higher latitudes.

The Trade Wind route.—Vessels bound to Melbourne should navigate in the SE. trades according to the instructions given in § 89. Once south of New Caledonia, they should approach the coast of Australia in the manner described in § 139; the passage should be finished as stated in § 182. Sailing vessels are almost certain to have head winds and squalls between New Caledonia and Melbourne, (§§ 6 and 7.) It will be especially difficult to pass through Bass strait, as January, February, and March are the only months when occasional easterly winds may be expected.

During these months, and from November to March in general, vessels bound to the Indian ocean and Batavia should, after sailing over the route just described pass to the southward of Australia. This part of the route will be found in detail in § 176.

It is possible to pass north of Australia at all seasons; the weather being better by this route. From March to September there will therefore be a choice between Torres strait, which can be traversed with the SE. monsoons and the route by St. George channel and the north of New Guinea.

In either case pass north of the Samoa islands, close to the southward of Rotumah island and north of the New Hebrides. For further information see § 175. During the other season, from September to March, the NE. trade route can be taken, § 92. Make the Bashee islands between Formosa and Luzon, and run down the China sea with the NE. monsoon. Instructions relating to the latter part of the voyage will be found in § 166 and subsequent sections.

The Cape Horn route (Horsburgh).—When the destination is Réunion, Bombay, Calcutta, Batavia, or even Saigon, quicker passages will undoubtedly be made by this route. It will be particularly advantageous for ships leaving Valparaiso and Callao, between the months of August and January During this season the weather will not be so severe in that part of the passage made in high latitudes; the temperature will be warmer, and, the days being longer, the floating ice can be more easily avoided. Moreover, during this season, the trade-wind passage will be more uncertain, as bad weather and westerly winds are common in the western part of the intertropical zone.

During the rest of the year, and particularly when starting between March and June, the SE. trade passage can be made with steady winds; the weather will be fair, and the difference in time between the two routes will be little or nothing. It is well understood, however, that the only route at all seasons for good and well-equipped vessels bound to Réunion or Bombay, is that by the cape.

One of the inconveniences of the southern route, especially during the winter, when the nights are very long, is the danger of meeting icebergs. The chances of running foul of them can, however, be diminished after leaving cape Horn, by steering so as to cross 40° S. near 41° or 42° W., when run down the easting; but this circuit will greatly increase the length of the voyage, and a more rapid passage will probably be made by gradually shaping the course (after leaving cape Horn) for 40° S. to the eastward of 28° or 29° E. if bound to Réunion; for 40° S. at 37° or 42° E. if bound to India, or near 62° E. if the destination is Batavia.

Maury gives the following instructions for this route:

"The distance by the way of the cape to Calcutta is 10,500 miles; while the distance by the usual route west, or 'running down the trades', as it is called, is 13,000. The difference in time will be quite as great as this difference of distance would indicate. Indeed, in addition to distance, time is also in favor of the cape Horn route, for the winds are stronger and quite as fair.

The way by the Cape Horn route to India is to proceed from Valparaiso as though you were homeward bound around the cape, and then, with the West winds which prevail there, to run east with flowing sheets, passing between the isles of South Georgia and the Sandwich group, keeping a bright lookout for icebergs. The route thence crosses the prime meridian in about 54° S., 20° E. in 50° S., 35° E. in 40° S. by which time the navigator will again find himself in the traveled thoroughfares.

Distance in miles from Valparaiso via—

	Cape Horn route.	Western route.
To Canton	11,500	10,800
To Shanghai	12,200	10,500
To Java head	9,700	------

In the southern summer the voyage from Valparaiso to Canton may, on account of the winds, be performed quite as quickly via cape Horn as it may be by the route west. If the West winds will enable a ship by cape Horn to average only 10 miles a day more during the voyage than she can by running down the trades west, time, which now is worth so much in navigation, would be somewhat in favor of the Cape Horn route, even to Canton."

§ 91. **Route from Valparaiso or Callao to New Caledonia and New Zealand.**—General observations on this route will be found in § 89, to which we will add the following instructions:

After leaving Valparaiso, especially in an auxiliary steamer, and when the sun is in the southern hemisphere, the route lies through the southern part of the Paumotu archipelago and along the parallel of 20° S. But sailing vessels will, we think, always do better if they steer for Fatu Hiva, after entering the trades. Starting from Callao, they should certainly head for the Marquesas. After correcting their position by sighting Fatu Hiva they should follow the instructions given in § 133 for vessels bound to New Caledonia and New Zealand.

As a general rule, it is always easy to reach Noumea since this route lies entirely in the trade belt. The wind will always be found steady, and especially settled, from March to October.

From December to May.—Ships bound to New Zealand during these months should steer, after leaving Fatu Hiva, so as to pass to the west of Cooks group; thence south of Nicholson shoal; they should cross the tropic near 173° W., and pass to the westward of the Kermadec isles.

From May to November.—At this season it is preferable to pass to the northward and westward of the Tonga islands and to intersect the tropic near 180° or 178° E. From this west point there will be fewer chances of being set to leeward after running out of the trades and while heading for the Bay of Islands with the prevalent westerly winds (§ 132).

§ 92. **Route from Valparaiso or Callao to China.**—The passage from South America to China may be made by either the NE. or SE. trades. These two routes are called, respectively, the northerly and southerly, or by the Horn route (§ 90).

The southerly route is to be preferred by vessels leaving Valparaiso or Callao from February to July. The northerly route is the better one during the remainder of the year.

The Southerly route—First head, as has been stated in §§ 89 and 91, so as to make Fatu Hiva, thence steer to the southward of the Gilbert group and to the northward of the Pelew islands. After this shape the course—if the passage is being made between March and October—to pass southward of the Marianas, if deemed advisable. Grau island can be sighted, its south side is high, steep, and mountainous, the north end low; then steer for the strait of San Bernardino with the NE. winds. These will gradually change to variables with squalls, and then to SW. monsoon as you approach the Philippines. Pass between Luzon and Mindoro with the monsoon, cross the China sea, heading directly for the Great Ladrone making it bearing N. by E. or North. But from October to March, after leaving the Pelew islands, keep to the northward of the Philippines, and gain the China sea by passing through the Bashee group. Thence the passage to Hongkong will be easy, the NE. monsoon being favorable.

There is also another route which has its advantages for ships coming from the coast of America from February to July. To follow it, steer after sighting Fatu Hiva so as to intersect the line near 166° or 168° W. Then take a NW. direction, and pass north of the Marshall group. After crossing the line at 166° W., vessels can equally as well pass between Bonham island (Ralick group) and Mulgrave island (Ratack group), and then make to NW. between the two chains of islands. In both cases, after they have once passed to the northward of the Marshall group, they will make rapidly to the westward, keeping to the southward of Guam island (Marianas); after this make for San Bernardino strait, in the same manner as advised during the SW. monsoon.

Northerly route.—After leaving Valparaiso or Callao head with the SE. trades to cross the line near 138° W., and 10° N. near 143° W.; the NE. trades will be found near this parallel. The parallel of 18° N. should be crossed in the neighborhood of 160° W. Thence follow the instructions given in § 101.

§ 93. **Route from Valparaiso to Marquesas and Tahiti.**—Vessels starting from Valparaiso and bound to the Marquesas islands should cross the tropic near 88° W. and 12° S. at 108° W., and then lay a course straight for Fatu Havi; from this island the anchorage in Taiohae bay (Nuku Hiva) is easily reached. Sailing ships bound to Tahiti will also find it to their advantage to use the same route. After sighting Fatu Hiva they can run through the Paumotu group, as in § 94; but it is shorter to cross the tropic near 98° W. and 20° S. near 118° W., and make the westing through the archipelago on this parallel, which is comparatively clear of dangers.

According to Wilkes, a ship may keep on the 20th parallel until she reaches 141° or 142° W., and then head for Tahiti direct. On this route Carysford island (Tureia) will be sighted to the southward at about 138° W., and Whitsunday island (Nukutavake) to the northward at about 139° W. Still keep on the 20th parallel and run between Barrow island (Vanavana), long. 139° 05′ W., and Byam-Martin island (Pinaki), long. 140° 25′ W. Thence pass to northward of St. Paul (Hereheretue), long. 145° 05′ W. All these islands are visible at a distance of from 7 to 10 miles.

Captain Richard Fay gives the following directions for making a land fall at the Society islands from the southward: "It is always dangerous to approach the Paumotu group from the southward or southward and westward; pass west of Murea, and then steer for Tahiti. However, it is an easy matter during the good season to make Tahiti from the east by passing between Anaa and Maitea islands, and very near the latter. Keep a good distance from the NE.

coast of Tahiti, and make the landfall at Venus point; but do not run in closer than 6 miles, on account of the reefs which extend for 4 or 5 miles off shore, especially between Mahena and an islet situated to the east of Venus point.

By following this last route you will be able to make to the northward on the starboard tack, with a free wind, which afterwards hauls aft as you approach the land. When as high as point Venus you can run inside the reef by the Tanoa or Papiete passage, according to the appearance of the weather. The pilot will, however, come on board and take the ship by one or the other of the passages to the anchorage of Papiete, where come to in 7, 8, or 9 fathoms of water; bottom, sand and mud.

Vessels coming from the east or Valparaiso, and bound to Nuku Hiva, should sight Fatu Hiva, situated to the southward of Nuku Hiva. They should then head for Taiohae bay or Comptroller bay. The latter is situated on the eastern coast of the island and is larger than the former; but it is far from the French station and the residence of the chief at Taiohae."

§ 94. **Route from Callao to the Marquesas and Tahiti.**—After leaving Callao or any of the adjacent ports the course should be West to gain the trades, which will be found quite near land. Afterward, there are two routes, either of which may be followed. The first is a direct one to the Paumotu islands; the second takes the navigator within sight of Fatu Hiva, and then along the northern edge of the Paumotus.

Both passages are easy, and only demand attention while passing the low islands of the Paumotu group. The trades grow fairer as the ship clears the coast. In the neighborhood of the Paumotus they often become squally and variable.

Apropos of the direct route we will cite Wilkes's remarks:

"Coming from the eastward, from Callao for instance, the most direct route is to follow the parallel of 18° 30′ S. You will thus sight Clermont Tonnerre island (Pukaruha), long. 136° 20′ W., and can pass either to northward or southward of Serles island (Reao); thence shape the course to double Akiaki to the northward, and pass Harp island (Hao) to the southward. Afterward sail to the southward of Dawhaidi (or of the two groups, Ravahere and Marokau), and head for Tahiti."

There is still another route, on the parallel of 15° S. By this you will first sight Honden (Puka Puka), from which make a straight course for Kotzebue (Aratika), or the northern part of King (Taiaro). Thence pass to the northward of Vincennes (Kauehi), and to the southward of Elizabeth (Toau) and Greig (Naiu), and steer for Tahiti."

As we have stated, it is preferable to sight Fatu Hiva before making for the Paumotu group. This is the most frequented from Callao or Paita to Taiohae bay (Marquesas).

A westerly current may be looked for in this passage running at the rate of at least 10 miles per day. If no observations can be obtained it will be well to count on a speed of 20 miles, especially if the course be for the Paumotus direct.

§ 95. **Route from Valparaiso or Callao to the Hawaiian islands.**—After losing sight of the coast of South America make for the SE. trade region, steering NNW. or NW. from Valparaiso and West from Callao. After reaching the trades head for the crossings mentioned below.

From June to October cross the equator between 133° and 138° W., and 10° N. at 140° or 141° W, thus avoiding the constant calms which prevail to the eastward of 133° W. Ships generally carry the SE. trades to 10° N., and even beyond that parallel; passing from one set of trades to the other without intervening calms.

From October to June cross the line between 132° and 134° W., and 10° N. at 138° W. The ship will lose the SE. trades between the equator and 10° N. and experience few or no calms.

Beyond 10° N., steer with the NE. trade winds so as to fetch well to windward of the port of destination, keeping well to the east of Hawaii, and stand in for the land on a parallel north of the port. Navigators should remember that the Equatorial current may set them to the westward and to leeward. If bound to Honolulu, they should make the island of Maui from the northward.

§ 96. **Route from Panama to Australia, New Caledonia, and New Zealand.**—Starting from Panama and bound to the west, it will be advisable to make as much southing as possible in order to reach the SE trades (§§ 63 and 77). Vessels whose destination is Australia should therefore head on the same route as that described for the passage to San Francisco or Callao.

It will generally be very advantageous to cross the line east of the Galapagos, near 83° W., when possible. Auxiliary steamers will, of course, always follow this easterly route. If compelled to pass north of the Galapagos, the chances are great that they will be detained by calms and light, baffling airs, except during October, November, and December, when the winds are more settled.

After the trades are once reached to the southward of the line, they should steer for the high lands of Fatu Hiva. For details concerning the remainder of the voyage see § 91.

§ 97. **Route from Panama to China.**—First follow the routes given in the preceding section, and that for making the passage from Panama to San Francisco contained in § 63.

If the point of departure be Central America or Mexico, follow the instructions given in § 64. An example of this passage will also be found in § 99. These instructions all apply until the region of steady NE. trades is attained.

Vessels should afterward steer (with the NE. wind) a course that will bring them to the meridian of the Hawaiian islands between the parallels of 15° and 20° N., and then finish the voyage as described in § 101.

§ 98. **Route from Panama to the Marquesas and Tahiti.**—After leaving Panama make to the southward as much as possible, until the SE. trades south of the line are reached. Then head for Fatu Hiva, and finish the voyage as described in §§ 103 and 130.

§ 99. **Route from Panama to the Hawaiian islands.**—Reach the SE. trades as soon as possible, following the instructions given in §§ 63 and 77. Afterward cross the equator near 128° W.; 10° N. near 138° W.; and finish the passage in accordance with last part of § 95. Be careful to reach a parallel to the northward of the destination as soon as possible.

It is best at all seasons, when approaching the Hawaiian islands, to give Hawaii a wide berth, and to make the land on the north coast of Maui. Do not anchor off Honolulu during the four winter months (from December to April), as the southerly squalls are dangerous and the holding ground poor. During the rest of the year vessels can safely anchor in from 15 to 20 fathoms; bringing Punchbowl to bear NE. by E., and the point on Diamond head E. by S.

§ 100. **Route from San Francisco to Australia, New Caledonia, and New Zealand.**—We will first give Maury's instructions for the passage from San Francisco to Sidney:

From California to Australia the route out of San Francisco should be down as soon as possible into the NE. trades, as though you were bound to China, India, or the Hawaiian islands, crossing the equator anywhere between the meridian of 140° and 150° W., according as you prefer to run down your westing principally in the NE. or SE. trades.

I give the preference to the latter, because they are more steady, reliable, and certain, at least such is the rule. The distance by this route to Bass strait will be about 7,000 miles, and an increase upon this of the average distance to be sailed on the passage going, together with the distance returning, will not amount, as before stated, to more than 600 or 800 miles.

Aim to cross 30° S., on the passage from California to Australia, in the neighborhood of 170° E. Thence the course is between Australia and New Zealand, direct for your port.

In these passages, as on the California routes generally, navigators have to cross the calms of Cancer and Capricorn, as well as those of the equator, which latter are found between the NE. and SE. trade winds, but upon different parallels, according to the season of year.

It may therefore be remarked here, once for all—and which remark navigators, bound either from the United States or from

Panama to California, are requested to bear in mind—that the barometer will often enable the navigator to tell when he has crossed these belts of calms and entered the trades."

The course should, therefore, be first down into the region of the NE. trades, as stated in § 69. After reaching these steady, settled winds, make the following crossings:

From January to July, cross 10° N. at 143° W., and the equator at 148° W.

In January, February, and March, no calms, properly speaking, will be found between the NE. and SE. trades.

In April, May, and June there will be only about 2 per cent. of chances of calms in this region.

In July, August, and September, cross 10° N. at 148° W., and the equator between 150° and 153° W. In this season, and if the precaution be taken not to follow a more easterly route than the one indicated, there will be only from 2 to 3 per cent. of calms between 10° N. and the line.

From October to January, cross 10° N., at 138° W., and the equator at 143° W. By following this route there is only from to 2 to 3 per cent. chances of calms between the two trade wind regions. Farther to the westward, at this season, the ship would be liable to meet more calms.

At all seasons cross 10° S. near 154° or 156° W., or anywhere between those meridians. For information regarding the termination of the voyage, see §§ 91 and 132.

§ 101. **Route from San Francisco to China** (Maury).—Reach the NE. trades as soon as possible; then run to the west, on a parallel not too near the northern limit of the trade winds, thus avoiding the "horse latitudes." In order to do this choose some parallel between 20° and 15° N., keeping near 20° N., between June and October; and, on the contrary, in the neighborhood of 15° N. between December and March. At all seasons pass south of the Hawaiian islands and north of the Marshall group.

From May to October, when the SW. monsoon prevails, keep to the northward of the Carolines islands, and leave the Marianas on the northern hand. If deemed advisable Guam Island can be sighted. The island is low on the north coast, but quite mountainous and steep on the south side. Afterward steer for the strait of San Bernardino, with the NE. winds. These will gradually change to variable winds with squalls, and then to the SW. monsoon as the vessel approaches the Philippines. Enter the China sea by the passage between Mindoro and Luzon. Keep a lookout for leeway while approaching the coast of China.

From October to April, when the NE. monsoon prevails, run north of the Mariana group, sighting, if convenient, the Farallons de Pajaros. These are volcanic rocks, the highest of which has an altitude of about 800 feet. Some captains pass between the Grigan islands and Assumption; the former are a mass of mountainous rocks, the most elevated peak being about 1,300 feet high. Assumption is a volcanic cone; its diameter at the base is about one mile, and its height about 2,600 feet. It will generally be best to pass to the northward of all the Mariana group, as we have before stated; quicker passages are generally made in this way.

The entrance to the China sea is by the Bashee islands.

Note on the passage via the strait of San Bernardino, on the voyage to Hongkong, from June to October.—Before entering the strait of San Bernardino, it is recommended, when the wind is from South or East, to sight cape Espiritu Santo, which can be seen for 40 miles. Leave the island of San Bernardino on either hand, according to circumstances, then pass to starboard of Capul, and to port of the islets off the SE. point of Luzon. Look out for currents which often run here very violently. Sail around Ticao from the east and north, and pass between Burias and Masbate, then between Marinduque and the islet of Banlon. Thence run between Mindoro and Luzon, and pass successively to the south of Green island and Maricaban; skirt point Santiago, and double from the north, at a good distance, Ambil, Lubang, and Cabra islands. From this position a ship can run up, off the west coast of Luzon, on a N. by W. course, and as far as cape Bolinao. Cross the China sea. During the SW. monsoon head direct for Great Ladrone, approaching from South or S. by W. During the NE. monsoon run for Great Lema and enter the neighboring channel.

From July to December look out for typhoons.

§ 102. **Route from San Francisco to the Hawaiian islands.**—After leaving San Francisco run for the trades with the prevalent northwesterly winds common on the coast.

From June to December clear the coast as soon as possible, steering WSW. for instance. The calms to the eastward of 128° and 133° W. will thus be avoided. The trades always blow south of the tropic of Cancer. Near the Hawaiian islands the trades may possibly haul to East, or even to SE.

From October to January, particularly, the wind may blow from SE. in the neighborhood of the tropic.

The land should be approached from ENE., when all the possible winds will be fair. When making a landfall remember that the currents often run at the rate of 20 miles per day, and that calms and baffling winds are common to leeward of the islands.

§ 103. **Route from San Francisco to Tahiti.**—The portion of this route from San Francisco to the trades is the same as that described in the preceding sections. Cross the equator between 118° and 123° W. from May to October, and between 113° and 118° W. from October to May.

Beyond the equator run for the high lands of Fatu Hiva, then through the Paumotu group toward Tahiti. As this island is surrounded by a belt of reefs be very watchful on nearing it. Artemise bank is especially dangerous. The following extract from Wilkes indicates the best passages through the Paumotus:

"When making passage from the north to Tahiti. my advice is to sight Rangiroa (Uliegen, Dean, or Nairsa), and to pass between this island and Tikahau (Krusenstern); this passage would appear to be the best and safest. If obliged to make the Paumotus more to the east (which will be the case when coming from Fatu Hiva), you can sight Ahii (Peacock); the position of the west point of this island is 14° 35′ S. and 146° 27′ W.; in this case the passage between Rangiroa (Nairsa) and Arutua (Rurick) can be taken. You can pass still farther to the eastward, between Raraka and Katiu (Sacken); before reaching these islands you can sight Taiaro (King), and afterward sail through the passage between Raraka, Katiu, and Tahanea. The wind often allows vessels to keep to the east of this last island."

We would also recommend another more westerly route. By this captains should first take the bearings of Napuka island (Disappointment), and then steer about SE., so as to make Angatau island (Araktcheff). Afterward double successively Amanu (Moller), Hao (The Harp), Nengonengo (Henry), and Hereheretua (St. Paul).

In all this advice the prevalent winds have been taken into consideration, or at least those which one has any probability of meeting. It is very evident that the Paumotus can be crossed in all directions by navigators at home in the group and by those willing to run the risks incident to this locality. The surest routes only are given, and by these routes several islands, where shelter can be found, are passed, and advantage may be taken of the resources of the group."

For further information concerning that part of the passage comprised between Fatu Hiva and Tahiti see § 129.

§ 104. **Route from ports north of San Francisco to Honolulu and the Western islands.**—Run down the NW. winds to the NE. trades; then continue as in §§ 102 and 103.

CHAPTER IV.

ROUTES FROM EUROPE TO AUSTRALIA, NEW CALEDONIA, AND TAHITI, AND RETURN ROUTES.

§ 105. **Route from Europe to Australia.**—This passage can be made by two different routes: first, by the cape of Good Hope, or the southerly route; second, by Suez.

1st. *The Southerly route.*—Vessels leaving Europe should cross the equator west of 25° W. from November to May, and east of this meridian from May to November. In the SE. trades they should run a little free, and always attempt to cross the meridian of the cape of Good Hope south of 40° S. Much depends upon the parallel on which the passage is to be made; the length of the voyage especially is dependent on the captain's choice in this matter

Yet the views of different authorities are widely divergent: Thus the instructions of the British Admiralty advise 39° S. as the proper parallel. In the extracts from these instructions, to be found farther on, useful observations are given on the passage to Sidney after leaving Tasmania. Horsburgh favors the same parallel, and expresses a very marked preference for the passage through Bass strait. In the present section will be found quotations relating to the proper route to be taken when the passage through this strait is used. If Maury is consulted, it will be noted that he is strongly in favor of the extreme southerly route, between the latitudes of 45° and 55° S.; the choice of the parallel depends on the season, according to him, as well as on the winds, the qualities of the ship, etc., etc.

The voyage to Australia only being made by good, staunch, well fitted ships, we think that the general instructions should particularly relate to the route to be followed under ordinary conditions. Our opinion is that merchant vessels should follow Maury's route, but without going too far to the southward. During the southern summer, and especially from November to February, they should keep on a parallel south of 43° S.; they can descend as far as 50° S., or even beyond that parallel. Quite rapid passages have been made in summer near 50° S. The weather is often better, the sea smoother than it is between 42° and 46° S., while the chance of meeting icebergs is the same.

During the southern winter, that is from May to September, the length of the nights (dangerous on account of icebergs) and the extreme cold will generally prevent vessels from going so far south. If the route be chosen between 42° and 45° S., we think a good passage ought to be the result at this season.

This advice accords with Maury's and that of many officers who have made the passage.

The logs of the Dutch merchantmen bound from the English channel to Java, prove indisputably that the ships which kept north of 40° S. met twice as many gales as those which kept south of the same parallel.

This observation being the result obtained from the mean of a great many voyages, seems to destroy the reasoning of certain navigators who think that by following the English Admiralty route they will have less bad weather.

This latter is also a longer route than the more southerly one, where the degrees of longitude are shorter, and it would also seem that navigators who choose it willingly place their vessels in a zone where the chances of storms are twice as numerous.

It also appears probable that there exists an intermediate belt, situated between 40° and 43° S., or thereabouts, where the winds are unsteady, very variable, and accompanied by rainy and damp weather. This belt, in which some captains believe the scurvy is apt to be developed, probably changes its latitude, following the declination of the sun; it is found, for instance, between 39° and 41° S. from May to August; and between 41° and 43° S. from November to February.

If it be decided not to follow the route south of 42° or 43° S., we think that the parallel of 39° is to be preferred to that of 40° or 41° S.

Ships following the Admiralty route on 39° S. will have warmer weather; but will generally make longer passages. It will, however, be shortened by going through Bass strait. Sailing vessels should, however, avoid passing through this strait during the months of January, February, and March, when the winds come out from ahead or the East.

Sailing vessels preferring the southerly route, between 43° and 52° S., more or less to the south according to the season, should not generally pass through Bass strait. They should rather round Tasmania to the eastward and make Sydney, as stated farther on at the end of our extract from the Admiralty instructions.

Auxiliary steamers following our advice and taking the southerly route, can shorten the last part of the voyage a little by running through Bass strait.

A vessel will, of course, be exposed to floating ice if she follows the southerly route; but the chances of meeting it are small on the parallel 39° S.

We consider the Admiralty route as disadvantageous to the interests of ship owners; we hold to our opinion, already stated, that the southerly route is the better; and that it presents no especial dangers to stout and well equipped vessels. Finally, we reiterate that the chances of meeting storms are less on the southerly route than on that of the 39th parallel.

There now only remains to find out if there be a greater chance of meeting icebergs on 43° S. than on 45° or 50° S. Now, nothing proves (§ 43), that vessels sailing on the various parallels between 43° and 52° S. should expect to see fewer icebergs at one edge of the belt comprised between these two parallels than at the other.

Icebergs are more numerous in high latitudes (from 60° to 50° S.); but they drift rapidly to the north and quickly leave these localities. On the contrary, after they have been carried beyond 50° S. they are set toward NE., then toward East by the current, and remain in warm latitudes until they melt. Still it is best, especially in the southern winter, not to go farther south than the 51st parallel.

Captain Guérin, commanding the *St. Paul*, gives the following account of his meeting with icebergs between 46° and 47° S. and 4° and 12° E.:

"On the 1st January, 1867, latitude 45° 51′ S., longitude 4° 28′ E., sighted an iceberg to port, distant 6 miles; sighted another two hours afterward. Next day strong breeze from NW., with thick fog; position at noon, 46° 31′ S. and 9° 08′ E. At 8 p. m., an immense mountain of ice loomed up in the fog right under our bow; succeeded in avoiding it. At 10.15 p. m. we passed close by a small detached piece of floating ice. This was the last, though we kept the courses clewed up all the night.

At daylight we were completely surrounded by icebergs. There were seven large ones, and numerous little bergs about them. At noon on the 3d January, latitude 46° 56′ S., longitude 11° 53′ E., took an ENE. course, in order to run out of these high latitudes; the advantages of the southerly route being hardly apparent, at least in January. We passed our last ice island on the night of the 3d and 4th.

Nothing announced the approach of these icebergs; the thermometer showed no sudden change in their vicinity. At 46° S. the temperature of the air was 41°, and the water 36½°. It was almost useless to keep a lookout at night, on account of the thick fog; and the greatest danger we had to fear was from the numerous little icebergs that showed for only a few feet above the sea. The principal bergs were from 160 to 330 feet high. They should, by right, drift faster than the small ones; consequently, to avoid them, I think it is best to cross the groups on the side of the largest berg. The only peculiarities I noticed in this region were the thick fogs, the absence of birds, and unusually smooth sea, and some old pieces of wreck."

We extract the following table from the Annales Hydrographiques (vol. 18). The reader should also refer to § 43:

In the mouth of—	Latitude S.	Longitude.	Name of vessel.	Remarks.
	° ′	° ′		
January	At 44 00	2 40 W	The White Swallow	Met floating ice.
	45 33	10 40 W	do	Met three icebergs, one of them 100 feet long and 150 feet high.
	43 40	16 40 W	The Malay	Met twenty-six icebergs of different sizes.
	42 18	12 08 W	do	Met thirty-four icebergs of different sizes.
June	45 00	48 43 E	The Panama	Met two large icebergs.
July	49 32	8 30 E	The Beverly	Met an ice field and icebergs.
	48 35	11 00 E	do	Met forty icebergs.
	47 15	16 03 E	do	Met thirty icebergs.
	46 50	20 23 E	do	Met two icebergs.
	47 30	19 25 E	do	Met one iceberg.
	48 08	37 45 E	do	do.
	48 44	43 00 E	do	do.
September	46 00	12 00 W	The Gertrude	Met one large iceberg.
	47 30	10 55 W	do	Met two small icebergs.
	49 24	1 39 W	do	Met two icebergs.
	48 15	45 00 E	do	Met one very large iceberg.
	52 10	37 07 E	The Great Britain	Met two large icebergs.
October	50 09	29 26 E	The Marion	Met one large iceberg.
	40 39	46 10 E	do	do.
	53 12	21 23 E	The Auckland	Met a field of ice and two icebergs.
	51 10	26 20 E	do	Met one iceberg
November	52 26	19 42 E	The Oriental	Met one large iceberg.
	52 20	27 47 E	do	Met three large icebergs.
	51 03	32 21 E	do	Met four large icebergs.
	51 20	37 06 E	do	Met one large iceberg.
	53 51	86 40 E	do	Met two large icebergs.
	43 38	8 15 E	The Flying Dutchman	Met four large icebergs.
December	52 57	95 20 E	The Oriental	Met one large iceberg.
	43 33	18 10 E	The Kongleader	Met two large icebergs.
	48 45	37 24 E	The Malay	Met one iceberg, well worn.

Having giving these general considerations, we will now quote some of the most important passages from the Admiralty instructions, Horsburgh, Maury, and Desnoyers. We will afterward give a few extracts from the logs of ships which have made this passage. After a perusal of these various authorities each captain can form his own opinion, which, we candidly admit, may be very different from our own. At whatever conclusion the navigator may arrive, he will, however, find several authors for and several against his route. Our preceding advice seems to us correct for merchant vessels, and is based on all past experience; the accumulation of twenty years' knowledge proving the correctness of Maury's theory, that the southerly route is the better.

The Admiralty instructions.—The English Admiralty give the following instructions on the "Route to Australia:"

"Should the southern route to Sydney be preferred, a ship running down her longitude in 39° S., as recommended, and having arrived at 130° E., should get to the southward of Tasmania on the meridian 145° E., before making the land, in order to avoid falling in with its rocky western coast in the night, from any error in the reckoning, or being caught on a lee shore by a SW. gale. After rounding the south cape, a ship, not bound into Hobart Town should give a berth of at least 20 or 30 miles to cape Pillar and the east coast of Tasmania, by which she will escape the baffling winds and calms which frequently perplex a ship inshore while a steady breeze is blowing in the offing. This is more particularly desirable in summer, when easterly winds prevail, and a current is said to be experienced on the SE. coast running to the N. by E. at the rate of ¾ knot at 20 to 60 miles off shore, while inshore it is running in the opposite direction with nearly double that velocity. From 30 miles to eastward of cape Pillar, the distance to cape Howe is 350 miles; and the course N. by E. After just sighting the cape stand to the northward for port Jackson, remembering that there will probably be a contrary current running down the coast at a distance of from 20 to 60 miles from the land." (§ 29).

Horsburgh's instructions.—"Since the discovery of Bass strait, the passage through it is generally preferred to that around Tasmania, as it is equally as safe and greatly shortens the distance.

A vessel having passed the island of St. Paul, and intending to pass through Bass strait, may get into lat. 39° or 39° 15′ S., then steer east on this parallel. As she advances, the variation will rapidly decrease; in about long. 132° E. there will be 1° E.; and having advanced one or two degrees more to the eastward, she will begin to have more easterly variation; at King island, the west entrance to Bass strait, it is about 8° E. Although the opinion appears to be held by many that the passage is best made by keeping a high southern latitude, the propriety of adopting the parallel of 39° S., as above recommended, has been already confirmed by the experience of Captain Erskine, of H. M. S. *Havannah*, who performed the voyage from the cape of Good Hope to Sydney in the very short period of thirty-four days, leaving the cape on the 3d July and arriving at Sydney on the 7th August. Captain Tudor, R. N., when in command of the

East India steamer *Pluto*, however, met with baffling winds on the northern parallel, and was obliged to run to the southward for the westerly wind." *

Route through Bass strait.—Bass strait is the navigable route for all vessels passing round south of Australia, and is consequently much frequented.† King island divides its western entrance into two channels, that north of the island being far the safer of the two, and therefore the one constantly adopted.

Bass strait should be approached with caution by vessels coming from the westward, if not certain of their latitude, which ought to be correctly ascertained before they reach 143° E.; and the strait should not be entered in the night, unless the land has been previously seen or both latitude and longitude be known by observation. The parallel of 39° or 39° 15′ S., according as the wind may incline, is the best track for passing between King island and cape Otway; and a sight of either, or, preferably of both, will point out the true situation.

Westward of the north end of King island. at 30 miles distance, there are soundings from 65 to 70 fathoms, sand, which will indicate the proximity of this strait in thick weather. The only danger to be apprehended here is the Harbinger reefs, two patches situated nearly 6 miles to the northwestward of the north end of King island; but they are so far separated from it, and from each other, as to leave passages between them, in case of necessity, where the shoalest water found by the Cumberland schooner was 9 fathoms.

Having passed the north end of King island, on which is a light, a course should be made good from it for Sir Roger Curtis island, and part of this distance may be run in the night with a good lookout; the soundings in this track to the eastern part of the strait are regular, from 35 to 48 fathoms. fine sand and shells. The best track is on the south side of Sir Roger Curtis island and on either side of Kent group, keeping near the southernmost island of the group. If the south channel is chosen to avoid the Endeavor rock, then steer E. by N., if nearly before the wind, or on either side of this course as the wind may incline, taking care not to approach the northern long beach, formed between Wilson promontory and cape Howe, which becomes a concave lee-shore with a SE. gale. This makes the channel of Kent group preferable, at times, to those north of them; but with a steady NW. wind and settled weather either of the channels south of Redondo might be pursued occasionally. Then a course steered well to the eastward, to give a berth to the long beach, and cape Howe may be rounded at any reasonable distance.

Anchoring places.—The most convenient places for anchoring in the strait with easterly winds are: under the NW. end of King island; on the east side of New Year isles, which anchorage is now called Franklin road; port Philip; Hunter islands, between Three-Hummock and Barren (or Hunter) islands, taking care not to anchor too close to the weather shore, lest the wind change suddenly; and on the west side of Wilson promontory, in a case of necessity only, for this place is dangerous if the wind changes suddenly to SW., as a deep bay is formed between the promontory and cape Liptrap. There is also anchorage in the channel called Murray pass, formed by the islands of Kent group; and there is one anchorage in East cove on the eastern side of the pass, and another farther to the northward, in West cove (Erith island), on its western side. Strong squalls may be expected off the land and eddy tides near the shore.

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* It is worthy of remark that Horsburgh, while advocating the route by the 39th parallel, should quote one bad and one good route.

† It is frequented by vessels which have chosen 3° S. for their easting—a route we do not advise.

Maury's instructions:—"Vessels that are bound to Australia, after crossing the line in 30° W., can generally reach 30° S. between 30° and 20° W. The great circle distance thence to Melbourne is, if it could be followed, about 6,700 miles; but it crosses the barriers of perpetual ice, which forbid the passage through the antarctic regions. But if a vessel do not go south of 55° S. she cannot accomplish the distance to Melbourne from the parallel and meridian of 30° W. in less than 7,300 miles.

The majority of vessels bound around the cape of Good Hope cross the meridian of 20° W. between the parallels of 30° and 35° S. Here they generally aim to make a course a little to the south of east. But the great circle route to Australia would, were it practicable, require them to pass the parallel of 70° S. before crossing this meridian of 20° W. That route is the nearest which, being practicable, deviates the least from the great circle. From the moment that vessels leave the calm belt of Capricorn, between 20° and 30° W., this route is tangential to the parallel of the highest degree of latitude that they intend to make.

Admitting that the tropical calm belt is left near 30° S., the distance via the 'composite' routes—for the parallels of 45°, 50°, and 55° S. taken as 'vertices,' and from the meridians of 30° and 20° W.—is as follows:

1st. From 30° S. and 30° W. to 45° S. in 20° E.; thence east to 120° E.; and thence by tangent to Melbourne, is 8,000 miles.

2d. From 30° S. and 30° W. to 50° S. in 30° E.; thence to 100° E.; thence to Melbourne, 7,700.

3d. From 30° S. and 20° W., by tangent, to 45° S. in 30° E.; and thence, as upon the parallel of 45° from 30° W., to Melbourne, 7,600

4th. From 30° S. and 20° W., by tangent, to 50° S. in 40° E.; and thence to Melbourne, as before, from 30° W., 7,300.

5th. From 30° S. and 25° W., by tangent, to the parallel of 55° S. in 40° E.; and thence along this parallel to 90° E.; and thence, by tangent, to Melbourne, the distance is 7,300 miles.

These tangential curves are arcs of great circles, and the navigator who will not take the trouble to get out these curves, so that he may follow them to and from the parallel, or 'vertex,' upon which he proposes to 'run down his longitude,' but prefers the rhumb-line course, must make up his mind to the loss to be incurred, for even in the cases above quoted he will lose by the rhumb-line course from a few hours' to a day's sail, according to circumstances.

At any rate, when he comes to view the route to Australia as here described, he will perceive that the route to the cape of Good Hope turns off from it about the parallel of 30° S., and that, therefore, Australian-bound vessels need not hug the trades as close as the cape-bound vessels do. Here, then, as you clear the belt of the SE. trade winds there is a fork in the road—the vessel bound by the beaten track to the cape or Calcutta going to the east; but she whose destination is Australia should stand on to the southward, not thinking of hauling up to eastward until she clears the calms of Capricorn and finds herself well within the region of the trade-like westerly winds of the southern hemisphere.

She may then begin to edge away and haul up gradually to the eastward, crossing 10° W. between 40° and 50° S., according to the season, and reaching her extreme southern parallel in our winter months, near the meridian of 20° E. Upon this parallel (say from 45° to 52° S.) she should run along her 'vertex' till she cross the meridian of 100° or 120° E., when she may begin gradually to edge up for her port, but still keeping to the right of the rhumb line on her chart that leads to it. Hence, it will be perceived that Australian-bound vessels have nothing to do with the cape of Good Hope; nor should they wish to go within 600 or 800 miles of it.

The best crossing place of 25° or 30° S., that the SE. trades will generally allow for the Australian route, is about 30° W., a few degrees more or less. The distance from it to Melbourne is about 6,500 miles, the arc of the great circle crossing the prime meridian between the parallels of 70° and 75° S., the meridian of 55° E. between the parallels of 80° and 82° S. Here it reaches its greatest southern declination, and begins then to incline northwardly. Australian-bound vessels are advised after crossing the equator near the meridian of 30° W., say between 27° and 32° as the case may be, to run down through the SE. trades with topmast studding sail set,* if they have sea room, aiming to cross 25° or 30° S. at about 28° or 30° W., and so on; shaping their course, after they get the winds steadily from the westward, more and more to the eastward until they cross the meridian of 20° E. near 45° S., and afterward reach, if possible, 55° S. near 40° E. The *Nightingale* ran as for south as 57° S., and made the quickest time of all the passages we possess. Therefore, there will be a great advantage in keeping to the South of East, as much as the ice, etc., will allow, without attempting to return north until the meridians of 90° or 92° E. are reached. The best plan is to make the extreme southern latitude between the meridians of 52° and 82° E., afterward bearing away more and more to the north and east as Tasmania is neared.

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*From this it is evident that Maury does not advise that you should always cross, even the equator, very far to the westward, as some authors have accused him of doing.

Such is the best route to Australia, the highest degree of south latitude which it may be prudent to take depending mainly on the season of the year, the ice, the winds, the state of the ship, and the well-being of the passengers and crew. If the winds are not good and strong, bear south to look for them. In our summer, one will not have to go so far south to look for these winds as he will in our winter. The shortest passages, therefore, will probably be made in the southern spring and early summer, when daylight, the winds, the state of the weather, and all, except ice, are most favorable for reaching high southern latitudes.

I have endeavored to impress navigators with a sense of the mistake they commit in considering the cape of Good Hope as on the wayside of their best route to Australia. It is not only a long way out of the best and most direct route for them, but the winds also to the north of the 40th parallel of south latitude are much less favorable for Australia than they are to the south of this parallel. 'Sailing Directions,' issued by the British Admiralty, I am aware, recommend the Cape of Good Hope route, and the parallel of 39° S. as the best upon which to run down easting to Australia.

It is in the fall and winter months when the sea is most free from icebergs, for every one knows that icebergs are often seen in the North Atlantic in June, and not unfrequently from November to April are the worst months for ice along the Australian route. By May well nigh all that the summer heat could set adrift have been borne north and melted; the southern winter is the time when the icebergs are held fast, for then they are forming for the heat of the next spring and summer to break out and set adrift.

In recommending this new route, and a route which differs so widely from the favorite route of the Admiralty, I should remark that I do it, not because it is an approach to the great circle route, nor because it has anything to do with the composite track, but because the winds and the sea and the distance are all such as to make this route the quickest. I say the sea, because I suppose there is no more danger from icebergs, if a proper lookout be kept, than there is on the voyage between New York and Liverpool. I do not even see them mentioned in the voyage to Australia, except by three ships, namely: the *Malay*, on the 21st December, 1853, in lat. 48° 25′ S. and long. 35° 24′ E.; the *Oriental*, on the 11th December, 1853, in lat. 46° 25′ S. and long. 125° E.; the *Auckland*, on the 25th October, 1853, in lat. 53° 12′ S. and long. 21° 23′ E.

Furthermore, Horsburgh says that H. B. M. *Guardian* fell in with one, in lat. 44° 15′ S. and long. 44° 30′ E., on the 24th December, 1789; also that the French ship *Harmonie* met one in April, at lat. 35°·50′ S. and long. 18° E. In short it can be said that icebergs are very rare in these localities.

There seem to be two spots in the Pacific where icebergs are frequent, one near the meridian of the cape of Good Hope, the other in the neighborhood of the longitude of Australia. I therefore would advise navigators not to cross the prime meridian to the south of 45° S.; then to run for their extreme southern parallel—55° S., for example—near the meridian 40° E.

In further proof that the route recommended in the 'Sailing Directions' of the Admiralty is too far to the north I have prepared tables, and so far as the facts deduced from these tables go, they justify the assertion that for every degree you go south of the Admiralty route, you gain three days on the average, until you reach 45° and 46° S., for the averages of the tables are not below these parallels. I believe it will turn out that the best streak of wind, on the long run, is to be found between 45° and 50° S. It seems to be almost as steady between these parallels from the westward as it is anywhere from the east between the trade wind parallels of 15° and 20° S."

Captain Sallot Desnoyer's instructions:—"There seems to be a choice between two routes in making this passage: First, the Admiralty route, near 39° or 40° S.; second, the route, near 45° S., more or less to the southward of that parallel, according to the season and the winds. During the southern winter, when the nights are long and the weather cold, it is natural for one to hesitate before taking the southern passage, notwithstanding the fact that icebergs are less numerous than they are in summer. At this season the Admiralty route can be followed on the parallel of 42° S. I do not think there is any danger in running well to the southward in summer, for if icebergs should chance to be encountered, the long days will be of much assistance in avoiding them. Of course, the wind and weather will at all times be taken into consideration; and if settled winds are not found on the parallel chosen, the best thing to do is to run south, remembering that the farther south vessels go, the shorter their passage."

The observations of various captains on the choice of a parallel:—We will first quote the following extracts from volume 29 Annales Hydrographiques, relating to this very disputed question. Lieutenant Galeche, of the French navy, expresses himself in these terms:

"Maury advises vessels leaving the cape of Good Hope to run for the meridian of 32° E. near 45° or 50° S. latitude, thus approaching the great circle—which curves into still higher latitudes—as nearly as possible. This is without doubt the most direct route, being 300 or 400 miles shorter than the Admiralty route. By it the passage is shortened two days. But Maury himself admits that the voyage is boisterous and stormy, and should only be undertaken by stout ships, He speaks of the ships that have made magnificent passages from Europe to Australia by descending to 55° S.; but makes no mention of those which have been lost, or have sustained extraordinary damage to their masts and rigging. Therefore I think that a man-of-war, bound to her station in China or Oceanica, and wishing to arrive there in shipshape condition, should not go lower than 45° S. in summer and 40° S. in winter. Bad enough weather will be found even on these parallels, but in spite of it a good passage may be made. Going from Réunion to Bass strait, in the *Marceau*, I ran down my longitude on the 40th parallel; and from 67° E. on 36° S. I had no easterly winds (September and October) until I reached Bass strait."

Captain Veillet, of the *Hoogly*, says: "I scudded along the parallel of 50° S. for two weeks, with a violent West wind after me all the time; but I would not follow this route in a weak vessel."

Captain Fernaud, of the *Réunion*, who made voyages to the East Indies for fifteen years, makes the following remarks:

"The most convenient place to cross the equator, after leaving Europe, is between 23° and 28° W. After passing the Tristan islands, head for the parallel of 42° or 45° S., upon which run down the longitude. Here the sea will be found very much smoother and the weather better than on the parallels of 36° and 40° S. I have always experienced fine weather, variable wind, sometimes even exceedingly variable, but no gales; while between 36° and 40° S. the sea is very rough, the gales very violent, and the danger of damage to the ship great. Ater the heavy squalls there are generally two or three days of calms, when the ship will not make more than 2 or 3 miles per hour and labors greatly. The heavy squalls do not seem to be found lower than 40° S.; the wind begins from NE., jumps violently around to NW., and shifts gradually to West, then to SW., finally to South, where it dies away."

Captain Prouhet makes the following remarks (Ann. Hydr., vol. 31):

"The bad weather we experienced in our passages toward Tasmania gave us an entirely different idea of the 'brave West winds' promised by Maury. They undoubtedly blow, in the zone of variable winds, especially in high latitudes; but they are very variable, and suddenly shift, at times, to all points of the compass. One moment we would be sailing along with a moderate breeze, the next a squall would be upon us, strong enough to carry every mast by the board. We were continually shifting or taking in sail. The sea was also entirely different from what Maury would lead one to expect. Instead of the long swell that was to set us a little ahead of our dead reckoning every day, we very often experienced a heavy cross and broken sea, the waves breaking in all directions, and making the vessel labor violently. Nevertheless the route to the east, advocated by this superior American officer, is a good one; but navigators must not fall into the illusion that they are going to have good weather, for I found that all the descriptions fell short of the reality. The speed by this route is more rapid, and, as the crew cannot be drilled, they will not object to the rough weather."

The following is an extract from the report of Captain Binet, of the *Isis*, on the passage from Réunion to Sydney (Ann. Hydr., vol. 28):

Left Saint Denis on the 20th February; lost the SE. trades on the 27th, lat. 38° S., long. 54° E., and without experiencing a moment's calm, found a light breeze from NE., which soon freshened and shifted to NW.

From that time till the 20th March, when we sighted cape Otway (latitude 42° S.), we made 200 miles per day, with fresh winds from NNW. to SSW. The only change in the weather was that the wind lessened in intensity, now and then, for a few moments. We experienced a few calms and light airs near land in Bass strait."

We would call special attention to the following quotation from the report of Captain Jouan, relating to the passage of the sailing transport *Bonite*, from the cape of Good Hope to Sydney (Ann. Hydr., vol. 27):

"The routes to Australia, as prescribed by Maury and the British Admiralty, are essentially different. The Admiralty directs that the 39th parallel is to be followed in the Indian ocean as far as the meridian of 107° or 112° E., whether bound through Bass strait, or to the south of Tasmania. Maury, on the other hand, advises a ship to gain as high a latitude as possible. The Admiralty route, if not very rapid, offered more inducements for a transport like the *Bonite*, as her people were ill clothed, etc. We left the cape on the 2d May, and on the 24th were in sight of St. Paul, and south of the island. The length of the nights, and the want of a detailed chart of Bass strait, made me decide to go to the southward of Tasmania.

We found better and more settled weather on the parallel of 46° S. than nearer the equator. Between the cape and the south of Tasmania the currents were generally to the east, sometimes to the north. Along the east coast of Australia, from cape Howe to port Jackson, the winds, during the first two weeks of June, were gentle, and from WNW. to WSW., freshening at night; the sky was clear, and the stars very brilliant. The westerly squalls, common here at this season, are apt to set vessels from the land. We also encountered several thunderstorms, during which the wind shifted.

The barometer on this coast rises with the south wind, and falls with the north. Near the land, and when the wind is from WNW., the glass varies from $29^{in}.76$ to $29.^{in}92$, as the wind hauls to north or south.

The rain storms seem to have no appreciable influence on the barometer. On the evening of the 25th June we were in sight of port Jackson light.

The next morning there was a dead calm, and we were towed to our anchorage at Farm cove; at noon the thermometer stood at 59° or 60°. From cape Howe to Sydney the currents set us to the northward, when we were near land; and to the southward when we were about 60 miles off the coast.

While at Sydney I met several captains who were in the habit of making the voyage from London to New South Wales. All of them informed me that in winter nothing was to be gained by going through Bass strait. They differed as to the best route through the Indian ocean; some recommending the route along the 39th parallel; others maintaining that ships should go higher, and on the parallels of the Prince Edward islands, Kerguelen Land, and the Macdonald group (52° 40′ S).

In these localities the wind is steadier, but the weather stormy. Icebergs make this route dangerous in summer. Good passages have been made by both routes. All the captains said that vessels should never keep between 40° and 42° S., as the weather is never settled, and calms and head winds are common in that locality."

2d. *The Suez route.*—The reader should first refer to the observations on this route, which he will find in the "Navigation of the South Atlantic ocean."

Reference should also be had to § 149 of this volume.

From April to October a sailing vessel or an auxiliary steamer can, if need be, sail down the Red sea without great difficulty, for, at this season, the winds prevail from the north. Inversely, the passage from Aden to Suez will be impracticable during these months, and rendered too long for commercial purposes. During the rest of the year the north winds prevail only in the northern two-thirds of the Red sea. In the southern third they blow from South and SSE., often quite stiffly.

From October to April it is almost impossible for a sailing vessel to go either up or down the Red sea.

Sailing vessels wishing to pass through Torres strait should aim to arrive at the Malay peninsula between December and February, so as to take advantage of the NW. monsoon.

It is even then extremely difficult for a sailing vessel, or for an auxiliary steamer wishing to economize coal, to go through both the Suez canal and Torres strait. The only possible way of doing this is to descend the Red sea during the first of October, so as to arrive at the sea of Arafura in November or the beginning of December. In this manner the strong SE. winds of the Red sea will be avoided, as these do not set in until November. In the sea of Arafura the NW. monsoon will be found; but it should be stated that this is the worst season in the Indian ocean, especially to northward of the line, for the change in the monsoons takes place at this time.

In short, sailing vessels, or auxiliary steamers wishing to economize coal, should not go through Torres strait.

The best season to go down the Red sea is between April and October, for then the SW. monsoon will be found north of the equator; the easting can then be run down, and the line crossed in a good position to haul up on the port tack in the SE. trades. Bear away to the southward and eastward near 30° S., and pass south of Australia.

§ 106. **Route from Europe to New Caledonia.**—Navigators intending to make this passage should refer to the instructions given in § 105, as the route discussed in that section is nearly the same as the one under discussion.

We have already stated that sailing vessels should pass to the southward of Tasmania. We will now point out the best crossings thence to Noumea:

As will be seen the general rule for the last part of this voyage is not to edge away too quickly to north, and to pass, or at least reach, the meridian of New Caledonia before clearing the parallel of 35° S. Auxiliary steamers can naturally make a more direct route.

The following crossings are to be preferred between Tasmania and Noumea:

In January, cross 40° S. between 165° and 166° E.; 35° S. and 30° S. between 168° and 169° E.

In February, cross 43° S. at 155° E.; 40° S. at 163° E.; 35° S. and 30° S. at 168° E.

In March, 40° S. at 165° E.; 35° S. and 30° S. between 170° and 171° E.

In April, 40° S. between 156° and 158° E.; 30° S. between 163° and 165° E., and thence directly for Noumea.

In May, 40° S. between 158° and 159° E.; 35° S. at 163° E., and 30° S. at 166° E.

In June, 40° S. between 157° and 158° E.; 35° S. at 165° E., and 30° S. at 167° E.

In July, 35° S. between 164° and 166° E.; and 30° S. between 167° and 168° E.

In August, 40° S. between 154° and 156° E.; 35° S. between 161° and 162° E.; and 30° S. between 165° and 166° E

In September, 35° S. between 165° and 166° E.; and 30° S. between 167° and 168° E.

In October, 40° S. at 160° E.; 35° S. between 165° and 166° E.; and 30° S. between 167° and 168° E.

In November, 40° S. between 160° and 162° E.; 35° S. between 166° and 168° E.; and thence for Noumea.

In December, 40° S. between 162° and 163° E.; 35° S. at 167° E.; and thence steer for Noumea.

For instructions relating to the last part of the voyage, and to the landfall, consult § 112.

§ 107. **Route from Europe to Tahiti.**—The track from Europe to Tahiti by the cape of Good Hope follows the parallel of 50° S. or the belt comprised between 45° and 50° S. The passage is forty-five degrees longer in longitude than that to New Caledonia.

Ships bound to New Caledonia commence to bear north at 137° or 142° E.; while those destined for Tahiti should run to the east until they cross 173° or 168° W., a difference in longitude of fifty degrees. Tahiti is situated in 17° 30′ S., and Noumea in about 22° S., a difference of five degrees in latitude. The difference to Tahiti is therefore, in round numbers, fifty-five degrees, and the passage from eighteen to twenty days longer. The whole voyage from France to Tahiti can be accomplished in from one hundred and ten to one hundred and thirty days at most; while by the Cape Horn route, touching at Valparaiso, it will take at least from one hundred and twenty to one hundred and thirty days to reach Tahiti.

1st. *The Cape Horn route.*—Quick passages have been made by this route, but instances of them are rare. In the "Navigation of the Atlantic" instructions are given on the passage from Europe to and around cape Horn. The reader should also refer to § 44 of this volume. The last part of the voyage will be found in §§ 93 and 94.

2d. *The Cape of Good Hope route.*—Probably the passage from Europe to Tahiti via the south of Australia will be generally quicker than the one by cape Horn. The instructions given in §§ 105 and 106 should be followed until the ship is south of New Zealand, after which the crossings should be approximately as follows:

In January, cross 45° S. between 174° and 176° W.; 40° S. between 161° and 163° W.; 35° S. between 154° and 156° W.; and 25° S. between 147° and 149° W.

In February, 45° S. between 173° and 175° W.; 40° S. between 154° and 156° W.; 35° S. and 25° S. between 147° and 149° W.

In March, 45° S. between 169° and 171° W.; 40° S. between 155° and 157° W.; 35° S. at about 153° W.; and thence for Tahiti.

In April, 45° S. between 177° and 179° E.; 40° S. between 164° and 166° W.; 30° S. between 153° and 155° W.

In May, 45° S. between 174° and 176° W.; 35° S. between 163° and 165° W., and then head for Tahiti.

In June and July, 45° S. between 174° and 176° W.; and 35° S. between 157° and 159° W.

In August, 45° S. between 174° and 176° W., and 35° S. between 154° and 156° W.

In September, 45° S. between 174° and 176° W.; 35° S. between 151° and 153° W.; 30° S. between 148° and 150° W., and head for port.

In October, 45° S. between 174° and 176° W.; 35° S. between 158° and 160° W., and 30° S. between 152° and 154° W.

In November, 45° S. between 177° and 179° E.; 40° S. between 165° and 167° W.; 35° S. between 156° and 158° W.; 30° S. between 152° and 153° W., and 25° S. between 150° and 151° W.

In December, 45° S. between 174° and 176° W.; 40° S. between 157° and 159° W.; 35° and 30° S. between 146° and 148° W.

Ships generally pass west of Rapa island, and some distance to the eastward of Vavitao. For instructions concerning the end of the voyage, see § 141.

§ 108. **Route from Australia to Europe.**—There are also two ways of making this passage, viz.: the Cape Horn route and the westerly route by way of the cape of Good Hope or Suez.

1st. *The Cape Horn route.*—The Cape Horn route is the better and quicker for sailing vessels at all seasons of the year.

It passes right through the middle of New Zealand, therefore the islands can be doubled either to north or south; or after leaving Sydney vessels can take either Cook or Foveaux strait. We think that it is always best to pass to the southward of New Zealand and between the Snares and Auckland.

If the weather shows every prospect of remaining fine and the wind comes out ahead, there is no special reason for not taking Cook strait in the good season, especially if on board an auxiliary steamer. See § 8.

Cook strait.—A ship deciding to take this strait will find shelter at port Gore or Guard bay in case of strong SE. winds; if not up to these ports when the wind begins, she can anchor at port Hardy or in the harbor of Croisilles on the west side of D'Urville island. The latter anchorage is the better, for a heavy swell, caused by the tide, sets through the inlet at port Hardy. On approaching Cook strait with the NW. wind, mount Egmont will be sighted, situated in 39° 18′ S. and 174° 05′ E. It is a regular cone and very high, the diameter of its base being about 30 miles, and its altitude about 8,500 feet; its summit is always covered with snow. On the contrary, when nearing the strait with the SW. wind, endeavor to pass by cape Farewell, situated in 40° 30′ S. and 174° 42′ E.; but be careful to avoid the dangerous bank which extends to the east of the cape for 17 miles. This can be done by heading for Burnett or Knuckle mountain, a remarkable peak on the western coast of Massacre bay. Knuckle hill is about 2,000 feet high, has two round summits, the northern one being the higher, and lies 9 miles SW. from cape Farewell. The lighthouse on Bushend point can be advantageously used as a leading mark to clear Farewell spit.

Foveaux strait.—Only auxiliary steamers and ships bound to Otago should use Foveaux strait; it is 15 miles broad, except west of Ruapuke island, where it is less than 10. The variable wind and weather make navigation through this strait dangerous for a sailing vessel, and a sharp lookout should at all times be kept for SW. and NW. squalls.

The current along the SW. coast of South island sets south. Vessels striking the West wind out of Melbourne can take Bass strait, and pass south of Kent islands, heading about E. by N. in order to double Wright rock and Endeavor reef; thence pass south of New Zealand between the Snares and Auckland island.

If after leaving Melbourne an East or NE. wind is found, run SW. and between cape Otway and King island. After doubling the north point of this island steer about S. by E. and give the western coast of Tasmania a wide berth, for sea room will be necessary in case of one of the SW. squalls frequent in these parts; thence steer for the passage north of Auckland.

The choice of a parallel.—After passing New Zealand make for the parallel on which it may be decided to run down the longitude.

There are fewer parallels from which to choose on this route than on the one from Europe to Australia. Cape Horn being in 56° S., the easting will have to be made in quite high latitudes, in order to double the cape with plenty of sea room. Ships passing either north or south of New Zealand will then find themselves in respectively 45° or 49° S. latitude; even then they will be south of the Admiralty route of 39° S. From this it results that this passage is necessarily made in high latitudes, and that the voyage is rarely a long one, for the winds are here very stiff from the West.

Without fixing on any particular parallel, we will only indicate the route which we consider the best.

We think that a ship should at first steer to the east between 48° and 53° S., more or less to south or north, according to the season.

Farther south icebergs and cold weather will be encountered. By referring to § 43 it will be seen, however, that floating ice only passes beyond the 50th parallel from October to April, and that it may not be met with south of 50° even at this season. There is less danger of meeting ice from April to October. Therefore the extreme southern limit for this route to the east should be 50° S. from October to April, and 52° or 53° S. from April to October.

If willing to run every risk for the sake of a quick passage, make for 57° or 58° S., and run to the eastward on that extreme parallel; but we cannot advise such a high latitude.

In short 50° S. during the southern summer, and 52° S. during the southern winter, would seem to be the extreme limits. During the long days of December and January a ship might run a little higher; For instance, after crossing 98° W., bear to the south for the parallel of the Diego Ramirez islands, near 76° W. Both winds and currents will, of course, always be favorable for doubling cape Horn.

Instructions relative to the voyage from cape Horn to Europe will be found in the "Navigation of the Atlantic ocean."

Never hurry to the north, and of course do not pass west of the Falkland islands. We would also state that sailing vessels bound to

Europe should never, unless under very extraordinary circumstances, cross 30° S. west of the 28th meridian.

In January, February, and March cross 30° S. between 14° and 16° W.

In April, May, and June, 30° S. between 19° and 21° W.

In July, August, and September, sailing vessels should cross 30° S. between 8° and 10° W., and auxiliary steamers 30° S. near 27° W.

In October, November, and December, 30° S. between 7° and 9° W.

In general, the farther 30° and 40° S. are crossed to the eastward the quicker the passage.

Supply ports.—Saint Helena is the best supply port for sailing vessels, but port Stanley may be useful in case of necessity.

The West winds which take vessels so rapidly from the meridian of the cape of Good Hope eastwardly along the parallels of 50° to 60° toward Australia, will also bring them over eastwardly along the same parallels toward cape Horn. (Maury.)

"The investigations which have been carried on, concerning the winds of that part of the ocean, forbid me to recommend the Admiralty route to any homeward bound European or American vessel, under any circumstances whatever; always assuming that these directions are intended for ships that are seaworthy, properly fitted out, and sound. The average passage to Europe by this Admiralty route is one hundred and twenty days. Ships may occasionally find the easterly winds as low down south as the directions of the Admiralty suggest; but it is the exception, not the rule, so to find them. In proof of this I refer to the pilot charts of that part of the ocean, and shall quote other authorities.

"Returning by way of cape Horn homeward, the best route is to get south of the parallel of 40° S. as soon as you can, and then shape the course direct for cape Horn, recollecting that the farther you keep south of the middle of the straight line on your chart from Tasmania to cape Horn, the nearer you are to the great circle route, and the shorter the distance—the difference by the great circle and by the straight course on the charts being upward of 1,000 miles.

"In the passage from Australia to cape Horn, by keeping between the parallels of 40° and 60° all the way, you will, I am of the opinion, feel more or less the warmth and set of a current that passes south of Australia from the Indian ocean. Whether the boisterous weather to which a warm current in such latitudes would give rise will compensate for the advantages to be gained in other respects must be left for experience to determine. For my own part, I do not suppose this current to be as strongly marked as is our Gulf Stream in the Atlantic; though the passage from the capes of the Delaware to Liverpool may be considered as affording us the means of judging pretty accurately as to this passage from Australia—the chief difference being, I suppose, in the climate and the gales.

"The climate in the Pacific, along this route, will be found not quite so mild as is that along the European route in the Atlantic. But the gales in the Atlantic are probably more frequent and violent than they are in the south Pacific; at any rate, I suppose that such will be found to be the case until you reach the regions of cape Horn.

"The Australian routes present occasional opportunities for fine runs. In the South Pacific ocean, below the parallel of 35° or 40° S., and away from the influence of the land—as along this route, especially from New Zealand to cape Horn—the westerly winds blow almost with the regularity of the trades; and a fast vessel, taking a westerly gale as she clears the New Zealand islands, may, now and then, run along with it pretty nearly to cape Horn.

"These winds are already beginning to be known so well to the Australian traders that it is usual for them, I am told, when bound home by this route, to strike topgallant masts before leaving port. It is a voyage that tries ship and crew; but of all the voyages in the world, that part of it between the offings of Australia and cape Horn is perhaps the most speedy for canvas. There it may outrun steam."

2d. *The Westerly route.*—The Australia Directory advises ships bound from Australia to Europe or Hindustan, from September to April, to proceed to the westward, passing south of Australia and by Torres strait during the southern winter. Maury strongly opposes these directions, and with reason, as may be seen by reference to the extract in the first part of this section.

As, however, the opinion of the British Admiralty has much weight, we would refer the reader to § 176, where will be found a quotation from the directory.

Still, the Cape Horn route is, in our opinion, the best on which to make the return passage to Europe.

Vessels bound to Singapore, Cochin China, or Réunion, can round Australia either to north or south. Instructions relating to this passage will be found in §§ 175 and 176.

Auxiliary steamers will find this west route the more rapid, especially as they can make the return passage from Australia through the Suez canal.

A ship starting from Sydney between May and August can count on the SE. monsoon to set her through Torres strait. SE. winds will also be experienced while crossing the Indian ocean near the parallels of 12° or 15° S. Cross the equator a little to the north of the Seychelles, and run for Aden, under low steam if necessary. Before October a ship will probably have strong head winds all the way up the Red sea.

The worst time of the year to leave Sydney is between July and January. The NW. monsoon will at this season prevent the passage through Torres strait, and as the route north of New Guinea will be too long, the Cape Horn voyage will almost invariably be preferable. In January, February, and March, there is no reason why vessels should not run south of Australia, especially if their port of departure be Melbourne or port Adelaide (§ 176). After doubling cape Leeuwin run to the west with the SE. trades between 22° and 17° S., but do not cross 15° S. before reaching 62° and 64° E. Thence bear north, when the SE. trades will be replaced by the NW. monsoon, or rather by the variable winds from NW., SW., and SE., which generally come under the head of the NW. monsoon.

The NE. monsoon prevails at some distance north of the line, except toward the end of March and the beginning of April, when the change in the monsoons takes place.

At this time vessels will have to steam for Aden. From October to April the winds are from South and SE., in the southern part of the Red sea, and as far north as the 17th parallel.

The Suez route is therefore not favorable for sailing vessels, and only for auxiliary steamers from the beginning of May to the end of July, when they can pass through Torres strait. Of course, we do not bring the mail steamers into these considerations.

The Cape of Good Hope route seems hardly admissible for auxiliary steamers that can take the Suez canal, nor would we recommend it for sailing vessels. It is always a tedious passage, particularly when doubling the cape, in June, July, or August. During these months the weather off the cape of "Tempests" is alternately stormy and calm. Cyclones also are frequent from December to March in the neighborhood of Réunion. By all means take the Cape Horn route.

§ 109. **Route from New Caledonia to Europe.**—1st. *The Cape Horn route.*—The reader should refer to the first part of § 108, where he will find useful information.

The greatest difficulty on this route for a sailing vessel will be doubling the North and NE. capes of North island, New Zealand. We will, therefore, give the following instructions, which, if not absolutely indispensable, are at least very necessary for passing north of New Zealand. The passage through Cook or Foveaux strait is not advisable on account of the exceptionally bad weather which prevails near the west coast of New Zealand (§ 8). Ships often have to lie-to in this locality with a lee shore close aboard. Presuming that the ship is not pooped, she will be forced to run through Cook strait, with a gale of wind after her from NW., a bad horizon, no land in sight, and with the danger of being "broached to," etc. In fact, the climate to the west of New Zealand is about the worst in the world. and if she should chance to fall in with a good spell of weather it is not likely to last more than twelve hours. Even an auxiliary steamer will find it to her advantage to double North cape to the northward.

Therefore, after leaving Noumea, run to the southward and eastward for New Zealand; if in an auxiliary steamer do not hesitate to use even one-third of the whole allowance of coal; if in a sailing vessel remember that the length of the passage to Europe depends greatly on the time spent on this the first part of the voyage. From Noumea to 30° S. the wind will be from SE., but very variable. After leaving New Zealand use every means to make to the east and south; if, therefore, the wind should come out from South and SSE., take the starboard tack; if it should haul ahead, do not keep off to the north of East, but go about immediately. South of 30° S. the wind will become still more variable, when take advantage of it by either beating or scudding, as the case may be. Here steam will outrun sail. The worst months for doubling New Zealand are those between the beginning of September and the end of February.

After leaving North cape, it will be comparatively easy to double East cape and to pass east of Chatham islands. After crossing 48° or 49° S. between 158° or 163° W., run down the easting to northward of 50° S., from October to April; and north of 52° S. between April and October. Beyond 98° or 93° W., commence to bear away around cape Horn. We once more repeat that when detained for an unusually long time between Noumea and New Zealand, the whole first half of the voyage to Europe will be prolonged.

Beyond cape Horn, it will be the captain's own fault if he strike north too quickly and thus lengthen the passage; in other words, the passage will be a long one if 30° S. be crossed to the westward of 28° W. Navigators should particularly remember this and cross 30° S. somewhere between 7° and 21° W., according to the season and the instructions in § 108.

In the "Navigation of the Atlantic ocean" it is stated that the line should be crossed at the following points: In July and August, at 21° W.; in September, at 22° W.; in June, October, and November, at 23° W.; in January, at 25° W.; during the remainder of the year at 24° W.

After crossing the NE. trades rap full the easting for Gibraltar, or the channel will have to be made well to the northward, as the West winds keep to high latitudes in this part of the Atlantic.

There are may instances of quick runs from New Caledonia to Europe.

The *Garonne*, Captain Rallier, left Noumea on the 6th December, 1872, and anchored at Brest on the 7th March, 1873, ninety days at sea. The *Orne* left New Caledonia on the 8th June, 1873, put in at St. Helena on the 9th August, and arrived at Brest on the 11th September, ninety-four days at sea, and one day at St. Helena.

2d. *The Westerly route.*—It is generally conceded that the Cape Horn route is the only one for sailing vessels. Small auxiliary steamers, fearing the rough seas of high latitudes, can take the westerly route, especially if they are bound to one of the Mediterranean seaports, and pass through Torres strait and the Suez canal. In this case they should leave Noumea between the beginning of May and the last of July, or at the furthest not later than the first days of August.

The SE. monsoon will carry them through Torres strait without difficulty (§§ 140–175). Thence the track lies through the Indian ocean, between the parallels of 12° and 15° S., and crosses the line north of the Seychelles. Finish the passage as stated in § 108.

There is nothing to be gained by taking this route at any other season, for a ship would have to pass either south of Australia in January, February, or March, or north of New Guinea from October to January. In the latter case a large detour through Gillolo or Dampier straits will have to be made (§§ 140–175).

Sailing vessels should, therefore, never take the west route, and small auxiliary steamers only when they can leave Noumea between May and August, or when bound to one of the Mediterranean ports. Large auxiliary steamers can make a quick trip by this route, through Torres strait, and thence to Suez; always provided they start between May and August. At all other seasons they should take the Cape Horn route, particularly if bound to one of the Atlantic ports of the French coast and wishing to save coal.

§ 109. **Route from Tahiti to Europe.**—After leaving Tahiti keep the sails full and make as much to the southward and eastward as the variable direction of the trades will permit.

The prevalent West winds do not generally come north of 35° S. After finding them the ship should follow as nearly as possible a great circle route to cape Horn. Thus, after crossing 40° S. near 140° W., head her for 50° S. in the neighborhood of 123° W.; and 55° S. near 103° W.

Probably the passage will be nearly as quick, and the chances of meeting ice less, especially from October to April, via the following route: After reaching 40° S. steer nearly SE., if the winds allow. When near the highest latitude—50° S. from October to April, or 52° S. from April to October—run down the easting, keeping a little to the northward of this extreme latitude limit; for south of it the ice is dangerous. Do not commence to bear south until beyond 98° W., or rather near 93° W.; when steer to cross the parallel of Diego Ramirez islands near 76° W.; then double cape Horn.

It is impossible to indicate the crossings which should be made between Tahiti and the parallels of 35° or 40° S.; for they will be different according to the season and the direction of the wind. The wind south of Tahiti may be said to be generally from East and SE., yet even here it often blows from all points of the compass. The observations of two or three consecutive months go to prove that the direction of the wind is variable for almost every day.

The only advice, therefore, that can be given is to make south as soon as it can be done without hugging the wind; the West wind will be found near 35° or 40° S. The passage from cape Horn to Europe is the same as that in § 108.

CHAPTER V.

ROUTES FROM THE PORTS OF AUSTRALIA OR ASIA TO THE EAST.

§ 111. **Route from Australia to the western coast of America.**—*From port Adelaide.*—A ship starting from port Adelaide should proceed south of Tasmania. Off Melbourne the winds are generally westerly, and enable vessels to run along the south coast of Sir Roger Curtis islands, and thence, either north or south of Kent group.

If the wind comes out from the eastward, as it is likely to do in January, February, and March, pass west of King island, and well to the west of Tasmania. For the passage through Bass strait, see §§ 105–108.

From Sydney.—If the point of departure be Sydney, the beginning of the voyage should be in accordance with the instructions in § 108.

In all cases, after a vessel is once to the eastward of New Zealand, she should head, as near as the wind will allow, for her extreme parallel, or rather a little to the north of it; this extreme latitude will be 50° S. from October to April, and 52° S. during the rest of the year. Thence make the easting, but do not get to the south of these parallels if it can be avoided.

To Valparaiso.—If the point of destination be Valparaiso, do not make any northing until near 103° W. Cross 48° or 47° S. near 98° W., and approach the land to the southward of your port. Look out for a "norther" near the coast of Chile, especially during the bad season, from the end of May to September (§§ 29, 69–71).

To Callao.—Vessels bound to Callao can begin to bear to the northward after crossing the meridian of 123° or 120° W. They should strike the SE. trades near 90° W., and then steer for their destination, being careful to keep it bearing to the northward of NE., to avoid the necessity of hugging the wind in case it hauls ahead.

To Panama.—A ship about to make passage to Panama can follow a more westerly route than the above. She should sight cape San Francisco, and finish the voyage as stated in §§ 48 and 55.

To Mexico.—If going to Mexico, she should follow the same route, entering the SE. trades near 30° S. and 93° W., and crossing the line, either to east or west of the Galapagos islands, according to the season. For instructions relative to the last part of the voyage, see § 49.

To San Francisco.—When bound to San Francisco, Maury says to cross 45° and 40° S. between 150° and 140° W.; and the equator between

130° and 120° W. Information concerning the last part of this passage will be found in § 51.

From Australia to San Francisco.—When east of New Zealand, if you get the SE. trades, which you probably will, outside the hurricane months, pass through the islands going east or west of the Samoan group, and keep on to north latitude; when about 38° or 40° N. you will get the westerly winds. The SE. trades work into ENE. as you approach the equator. During the months from December to April take the eastern passage around the Pitcairn island.

Maury's instructions on the passage from Australia to California: "In coming out of the Victoria ports go south of Tasmania, or through Bass strait, as you have the winds and find it expedient.

"Being south of Tasmania makes it convenient to pass south of New Zealand, if the wind be fair, as in the majority of cases it will be. Having passed south of New Zealand steer for the parallel of 40° or 45° S., between the meridians of 150° and 140° W.; thence for the equator between 120° and 130° W.; crossing by a north course both the horse latitudes of the southern hemisphere and the equatorial doldrums; then run through the NE. trades as best you may, keeping a 'rap-full,' and running up into the variables beyond the horse-latitude calms of the northern hemisphere, if need be, to complete your easting, and make your port.

"If the winds be not fair for passing south of New Zealand, try Cook strait in preference to passing to the north of New Ulster.

"If you pass through Cook strait, then stick her well to the eastward, and take the eastern passage. On this passage you should run down your easting pretty well before you get far enough north to be bothered by the baffling winds of the horse latitudes, south. If these come as low down as 38° or 40° S., stand north the moment you feel them till you get the SE. trades; then cross these and the NE. trades, both as obliquely to the eastward as they will permit, with fore-topmast studding sail set.

"On this passage you will have, finally, to run down your easting when you get in the variables beyond the NE. trades, and, of course, you will aim to reach the parallel of 38° or 40° N., or even a higher one north, to do this. How far you will go north depends somewhat upon the distance you may be west of California when you lose the NE. trades. If you be only a degree or two from the land you will steer straight for your port without caring to get to the northward of it; but if you be ten or twenty degrees to the west of it, or even farther, then, of course, the distance to be run makes it an object to turn out of your way and go north in search of good winds.

"The most difficult and uncertain parts of this passage will be in the time required to cross the three belts of calms, and to clear the winter fogs of California. But for these the eastern passage, from Victoria to California, would be one of the most certain passages in the world.

"The distance from Victoria to California cannot be accomplished under canvas, by the eastern route, much short of 8,700 miles. But driving captains, with clipper ships under them, may expect to average, one trip with another, along this route, not far from 200 miles per day; for I feel assured there is no part of the ocean in which the winds generally admit of more heavy dragging and constant driving than they will in the extra-tropical regions of the south Pacific; say on the polar side of 43° S."

§ 112. **Route from Australia to New Caledonia.**—After leaving Sydney run to the eastward, without bearing north, until about 450 miles from the Australian coast. Then commence to make the northing and gain the exceedingly variable SE. winds, which are here termed trades.

The length of this passage, under sail, will be very irregular; perhaps only eight days, perhaps over three weeks. From June to September the voyage will be quite easy, and vessels can run straight away north. During the rest of the year the East winds come farther south; it will then be advisable to run farther to the eastward on the parallel of Sydney. The following crossings will give an approximate idea of the mean route:

In January vessels may follow the parallel of Sydney to 160° E.; cross 30° S. near 167° E., and then easily bear to the northward.

In February cross 155° E. between 33° and 35° S.; 165° E. between 31° and 33° S., and 30° S. between 166° and 167° E.

In March, 155° and 160° E. between 33° and 35° S., and the parallel of 29° S. between 166° and 168° E.

In April, 155° and 160° E. between 33° and 35° S., and 30° S. between 163° and 165° E.

In May, 160° E. near 33° S., and the parallel of 30° S. between 165° and 167° E.

From June to September vessels will be able to pass close to the east of Ball pyramid and to cross 30° S. in the neighborhood of 162° E., whence the passage will be easy.

In September and October they can reach 30° S. without difficulty between 162° and 164° E., and thence for Noumea.

In November and December they can follow the parallel of Sydney until they are near 162° E., and then bear away in order to cross 30° S. well to the eastward of 165° E., especially in December.

§ 113. **Route from Australia to New Zealand.**—Vessels bound to Otago harbor should pass through Foveaux strait. Those bound to port Nicholson should take Cook strait (§ 108). Those destined for Auckland or the bay of Islands, should double North cape and pass north of New Zealand.

Leaving Sydney from the beginning of September to the end of April, and bound to Auckland or the bay of Islands, first head SE. and then keep south of the 35th parallel until the ship is in the neighborhood of 170° E., when commence to bear to the NE. By steering in this manner a vessel will meet fewer head winds, as they blow from the East quite frequently north of 35° S. during the southern summer. When bound out of Sydney, from May to the end of August, a more direct route can be taken.

Vessels leaving Melbourne or port Adelaide should begin the voyage by passing through Bass strait, or going south of Tasmania, as described in § 108.

§ 114. **Route form Australia to Tahiti and the Hawaiian islands.**—A ship leaving Sydney for Tahiti from May to August can pass north of New Zealand, thence south of the Kermadec islands, and then make her easting south of 30° S., crossing that parallel between the meridian of 158° and 153° W. She can generally run between Vavitao and Tabuai.

From the beginning of September to the end of April.—Cook strait is to be preferred at this season (see § 108 for the passage through this strait). After leaving the strait run down the easting, doubling Chatham islands to the northward, and crossing 30° S. near the meridian of Rapa island. During the first season a ship can generally pass to the westward of Murea, and then go about for Papiete. During the other season make Tahiti from the eastward, and pass between Anaa and Meitea islands, as stated in § 93.

Vessels starting from Melbourne or port Adelaide can either go south of Australia or through Bass strait, according to circumstances (§§ 108 and 111). If they take the latter route, Foveaux strait can be used (§ 108) though we think that the passage between the Snares and Auckland islands will be preferable in either case. The parallel of 40° S. should always be crossed between 158° and 153° W.; and that of 30° S. between 153° and 143° W. Cross both 40° and 30° S. farther to the west in June and July than in December and January.

For instructions concerning the first part of this passage, see § 111.

To the Hawaiian islands.—From Sydney go through Cook strait (see § 108). From Melbourne and port Adelaide pass between the Snares and Auckland. Always cross 40° S. near 143° W. Thence pass near and a little to the westward of Pitcairn and Oeno islands. Cross the line in the neighborhood of 133° W., and finish the voyage as described in § 95.

§ 115. **Route from Singapore to the Molucca islands.**—A ship bound from Singapore to the Moluccas from May to September will find the SE. monsoon south of the equator, and the SW. monsoon north of it. She should at this season run south of the Anambas and Great Natuna, thence between Charlotte and Louisa reefs, being careful to give Friendship and north Luconia shoals a good berth.

The north points of Balambangan and Banguey can be passed close aboard and the exit made through Balabac strait; thence pass through the Sulu group, double the north point of Celebes, and make south through Molucca passage.

Balabac strait has three channels: the two near Balabac are narrow and rarely used; the southern one near Banguey is the best. Approached from the west, the high mountain of Kinibalu in Borneo is a good mark; its position is lat. 6° 5′ N., long. 116° 40′ E. There is also a conical peak on the NW. coast of Banguey island close to the shore; it can be seen for 40 or 50 miles; and is situated in lat. 7° 19′ N., long. 117° 06′ E.

Approaching the southern (and best) channel of Balabac strait from the west, guard against being set too far to leeward, during the season of the SW. monsoon. Fifty or sixty fathoms of water will be found about 35 miles off the west coast of Balambangan; and the north coast can be approached to within 5 miles.

The SE. monsoon prevails in Molucca passage prior to the month of October, and the NW. monsoon in November. In the first case the track, after leaving the north point of Celebes, passes near and to southward of the Tifori islands, thus striking the SE. monsoon well to the east. After the month of October steer from the north point of Celebes straight for Bouro and Amboina.

On the passage from Singapore to the Moluccas, from October to May, the NE. monsoons will be struck north, and the NW. monsoons south of the equator. At this season the passage should be made through Carimata strait.

After leaving Pedra Branca, run for 27 or 30 miles on an E. by S. course, if the wind permit; then 24 or 27 miles ESE., in order to get well clear of the Geldria and Frederick banks; thence steer to leave Saint Barbe on the north and run for Seruta. If the wind comes out from West or SW., Biliton can be doubled to the northward; thence pass south of Ontario reef and around the Montaran islands.

The best route through Carimata strait, especially in overcast weather, when coming from the NW., is to pass to the east of Ontario reef. Vessels should keep from 30 to 45 miles from Seruta and steer SSE., when the west point bears at least three degrees to west of North, and thus give Ontario reef a wide berth. After keeping the point on this bearing until well clear of the reef, steer so as to pass about 20 or 30 miles from Borneo. The depths along this coast will vary from 14 to 17 fathoms, increasing sometimes near the banks. South of Rendezvous (Kumpal) the depth of water is from 19 to 21 fathoms until within 30 or 33 miles SW. of pulo Mankap, nor should you approach any closer than this distance with a large vessel. If uncertain of the longitude, it would be well to sight Borneo, if possible, and then head SW., after doubling Rendezvous island, thus clearing Mankap banks.

In clear weather vessels can also go to the westward of Ontario reef. It will then be necessary to double Seruta at a distance of 15 or 18 miles, and to head SE. by S., or SSE. when that island bears NE. If it be not advisable to round the bank, the west point of Seruta should be brought to bear to the east of N. 8° E. Steer in this way until 25 miles south of the island, when the west point will be on the horizon, and will bear N. by E. By keeping on the same course a vessel will sight Montaran islands, and pass 15 or 18 miles to eastward of them; thence steer SE. by S., and leave Cirencester and Discovery banks on the west, and the reefs SSW. of pulo Mankap, on the east. Alongside of these banks do not run into less than 15 or 16 fathoms, nor into more than 20 fathoms near the banks on the west coast. The soundings are very irregular.

After running out of Carimata strait, head so as to pass about 10 miles south of Great Solombo; thence make your easting of 150 miles between the parallels of 5° 36′, and 5° 50′ S. A ship can run over Laars shoal (5° 43′ S.) if sure of her latitude; if not, she should run farther south, and not double Brill (Taka Rewataya) bank in the night time, as the currents are very strong and irregular. If running east of 5° 43′ S., the Tonyn islands will be sighted from the masthead in clear weather; they are situated near Brill bank. Continue to the eastward after doubling the Tonyn islands, and sighting Tanakeke, pass it at a distance of 12 or 15 miles.

When the wind is SW. during the day and the weather clear, head for Salayer strait, passing south of Mansfield bank. If Bantaeng mountain be visible, steer straight for Middle island, when the peak bears between N. by W. ½ W. and N. by W.; and then pass between this island and the one to the south.

During the night, the wind being uncertain and the weather overcast, the best plan is to pass inside of Mansfield bank and along the coast of Celebes. The soundings here extend from 6 to 9 miles off the coast, and a ship can anchor if necessary. On this route keep from 4 to 6 miles off the Celebes coast, until Bantaeng mountain bears N. by W. ½ W. After doubling Mansfield bank to the north, keep 12 or 15 miles off the coast. As soon as Middle island is sighted, keep well out to sea until it bears E. by N.; thence steer between Middle and South islands.

Once clear of Salayer strait, Amboina and the Banda islands are easily reached by passing successively to south of Hegadis and Binongka islands. But vessels bound through Pitts passage, from October to May, should run around the south point of Buton, and skirt along the shore until they reach the east point, passing to the west of the Wangi Wangi islands. They should then bear north for Wawoni islands, and thence run for the south point of Sula Bese; the currents in this locality set to the south and are very strong. If drifted to leeward of the north point of Bouro, they should pass to the southward and eastward of this island, between Bouro and Manipa.

§ 116. **Route from Singapore to Torres strait.**—The NE. and NW. monsoons blow from October to April; but sailing vessels should not leave Singapore for Torres strait until November, and then invariably pass through Carimata strait, as stated in § 115; thence they will have a choice of two routes through the Java sea: The first, the southerly route, especially adapted to sailing vessels; the other, the northerly route, more advantageous for steamers and auxiliary steamers.

The Southerly route through Java sea.—After leaving Carimata strait, steer for Bawean island, and pass it to the northward and eastward. According to Captain MacKenzie, a ship near Bawean at night should run for Giliang (or Pondi) island, a little to the eastward of Madura, and afterward cross Sapudi strait between Giliang and Sapudi. If, on the other hand, she should lose sight of Bawean before nightfall, she can run for Kangeang island, and pass it to the south and between it and the islet of Urk; thence the route is north of Lombok. Keep on this parallel, as it is free from all dangers, until north of Ombai strait, when run between Ombai and Kambing, or between Kambing and Babi, and afterward between Wetta and Timor, and between Kissa and the NE. point of Timor. This latter passage is 18 miles from the Timor coast. Once clear of the Java sea, run straight through the sea of Arafura for Torres strait.

The best and safest route is that which passes south of the chain of islands lying east of Lombok. To follow it a ship should conform to the preceding instructions relating to the manner of reaching the passage between Kangeang and Urk, or to those referring to the passage between Pondi and Giliang, and afterward run for Lombok or Allas strait.

Horsburgh states that the northerly currents in Lombok strait will lengthen the voyage, and that Allas is the best strait for vessels coming from Carimata during the NW. monsoon.

Babi strait is never advisable. After leaving Allas or Lombok straits run about SE. by E. for 150 or 200 miles, then 200 more E. by S., changing the course if necessary to pass south of Damo island. This island is situated to the southward of Rotti. Steer east from Damo, and thus run a few miles north of Echo bank, over which there are hardly 12 fathoms of water. After a run of about 560 miles from Damo island, cape Croker will be sighted to the southward. After passing about 20 miles from capes Croker and Wessel, head for the Wallis islands if bound through Endeavor strait, or for Booby island if making for Prince of Wales channel.

The Northerly route through the Java sea.—Some authors recommend the route through Salayer strait during the season of the NW. monsoon (§ 115, 2d part). This is a good route for auxiliary steamers and steamers, but we think the passage through the south of the Java sea will be a better one for sailing vessels. A ship taking the route through Salayer strait should steer east until the peak of Kambyna bears NW., then run SE. by E. for Ombai strait. She can pass between Ombai and Kambing, or between Kambing and Babi; thence between Kissa and the NE. point of Timor, and run for Torres strait.

During the SE. and SW. monsoons.—At this season, from May to September, only steamers can make the passage from Singapore to Torres strait. They should take the route through the south of the Java sea, as given above. They should keep to northward of the islands, on the parallel of 8° S., until they are north of Ombai strait; and then pass between Ombai and Kambing, or between Kambing and Babi, and thence as already stated. Kupang can be approached from the north through Ombai strait, or more directly through Moridja or Pantar straits.

§ 117. **Route from Singapore to the western coast of America.**—From October to May (during the NE. and NW. monsoons), the passage may be made in two ways, either by the easterly routes or by taking the route south of Australia.

The easterly routes are two: first, that by the north of New Guinea, described in § 170; second, that by Torres strait (§§ 116 and 179). For information concerning the route south of Australia, see § 180.

In a good vessel, the passage south of Australia will probably be quicker and safer. If this route be decided upon, follow the directions given in § 176, and keep a clean full through the SE. trades of the Indian ocean; thence make south for the steady West winds; these once found, head SE. for the parallel on which you intend to run down the easting; this parallel should be between 46° and 50° S. at this season. The track is close to the northward of Auckland island, and east of New Zealand is the same as that given in § 108 or § 111. Information concerning floating ice may be found in §§ 43, 105, and 108.

Navigators deciding to take one of the easterly routes, and preferring the one by the north of New Guinea, should conform to the instructions in § 179 and cross 10° S. near 172° E., and thence keep west of the Fiji group and east of New Zealand.

Between 45° and 48° S. the West winds prevail, but run still farther south, say to about 50° S., if bound to any of the ports of South America or around cape Horn.

Vessels choosing the route through Torres strait should first head according to the instruction given in § 116, then run through Prince of Wales channel and Bligh passage, and along the southern coasts of New Guinea and the Louisiade group. The winds in this locality are generally from West to NW.; therefore southing and even easting can be made with facility.

Vessels running north of New Zealand will have a quicker passage; but it will be difficult to double cape North at this season unless advantage be taken of every chance for making to eastward as well as to southward. If it be found impossible to double cape North run through Cook strait (see §§ 8 and 108). For information concerning the latter part of the voyage, see § 111.

From May to October.—During the SE. and SW. monsoons, ships bound to cape Horn and the ports of South America will find it greatly to their advantage to go south of Australia (§ 180), but they will encounter the severe weather of the southern winter, and should be well fitted out in every way.

The prevalent SE. winds will render the passage difficult as far as the strait of Sunda, but once in the Indian ocean a vessel can run across the trades rap full, and probably find the West winds at 30° or 32° S., and thence bear away to the SE. and run down to 50° or even 52° S. Pass either north or south of the Auckland islands, and keep to the eastward on the same parallel, then make north again as stated in § 111. For information in regard to floating ice, see §§ 43, 105, and 108.

But for Californian or Mexican bound ships the northerly route is preferable. They should, on leaving Singapore, cross the China sea, as stated in §§ 154 and 157, and enter the Pacific near the Bashee group, if sailers, or through the strait of Formosa, if steamers; 35° N. should be reached as soon as possible. Vessels taking the strait of Formosa will be less liable to meet typhoons, or if they should happen to fall in with one, there are plenty of ports of refuge. (§§ 20, 158, and 160).

By running through the Bashees a ship will be the sooner out of the dangers of the China sea, and can take advantage of the full force of the Black current, or Kuro Siwo (§ 37). Still, typhoons common in this neighborhood, especially in July and August, and even until November. The region of West winds once reached, the voyage should be finished according to the instructions given in §§ 120 and 121. Most of the easting can be run down between the parallels of 40° and 45° N., where both wind and current are generally favorable.

We have stated that vessels bound to South America should take the southerly route; but it should be understood that they can also take the northerly route. After meeting the West winds they should run down their easting north of the parallel of 40° N., commencing to bear south after passing 158° W., and the NE. trades should be left near 118° W. and between 10° N. and the equator. The last part of the track lies south of the line, as stated from §§ 68 to 72.

§ 118. **Route from Saigon to the western coast of America.**—This route is nearly identical with the preceding.

Thus, if it be decided to go south of Australia, during the season of the NE. monsoon (from October to May), run out of the China sea according to the instructions given in § 152; thence according to §§ 180 and 117. If one of the easterly routes be decided upon, run through Carimata strait, as stated in § 152, and then follow the advice given in §§ 116, 117, and 179.

During the SW. monsoon (from May to October), staunch auxiliary steamers bound to South America will find it greatly to their advantage to go south of Australia. They can fill up with coal at Singapore and make the first part of the voyage as described in § 174. They should then follow the route given in §§ 117 and 180. But auxiliary steamers making passage to the coast of North America, and all sailing vessels bound to any American port on the west coast, should take the northerly route at this season, and pass through Formosa channel or the Bashee group, as stated in § 117.

§ 119. **Route from China to Valparaiso, Callao, and Panama.**—Starting from Hongkong during the NE. monsoon (from October to May), the best and shortest route is that south of Australia. After sailing down the China sea, as stated in § 152, follow the instructions given in §§ 117 and 180. If, however, the port of departure be Shanghai or Yokohama, the northerly route will be the best. The ship will probably strike the West winds between 35° and 40° N., and should finish the voyage as described in the present section, under the head of SW. monsoon.

The only practicable route during the SW. monsoon (from May to October), is the northerly one. After leaving Hongkong steer for the Bashees in a sailing vessel, or for Formosa channel in an auxiliary steamer. Run down the easting near the parallel of 45° N., where both the winds and currents are generally very favorable, (§ 117). The NE. trades should be struck between 148° and 143° W.; and the SE. trade winds near 5° N. and between 118° and 123° W. From here shape the course as stated in §§ 68 and 72.

Maury gives a more westerly route, advising ships to run into the NE. trades near 152° E.; to cross the equator in the neighborhood of 172° E., and thence to pass either east or west of New Zealand. The last part of the voyage is easily accomplished.

But we think this route hardly advisable for sailing vessels, as several groups of islands are in the way; it is also difficult to double New Zealand, and there are many dangers in the route. An auxiliary steamer can, of course, steam around the northern end of New Zealand (§ 109).

§ 120. **Route from China to Mexico and California.**—Vessels always take the northerly route from Hongkong or Shanghai to the Mexican or Californian coasts, running to the northward and eastward at first, as stated in §§ 161–167. Although the winds of the SW. monsoon are favorable, typhoons are to be feared, especially from July to November. After the month of November, that is, during the strength of the NE. monsoon, the difficulty of beating to northward will be counterbalanced by the fact that the weather is generally less inclement.

The region of westerly winds once reached, the route follows the arc of a great circle as nearly as possible; it runs up as high as 48° N. from April to October, and keeps between 40° and 45° N. from November to March. Here both wind and current are favorable.

Maury says: "All vessels from China or Japan will first make for the variables, which they will find strong and good from the westward, between 35° and 40° N. in winter and spring; between 40° and 45° N. in summer and fall.

Vessels from China may follow pretty closely the great circle route, which crosses the meridian of 180° in about 50° N. The route in the Pacific is free from icebergs, and is not more foggy than that in the Atlantic."

The reader should also refer to the following section for further instructions:

§ 121. **Route from Yokohama to San Francisco and all ports north in the United States and British Columbia.**—This is an easy passage. The westerly winds will be found near 40° N., and the current will be favorable for the ship almost as soon as she is out of sight of land.

Vessels should follow a great circle route as nearly as possible, though it is not advisable to pass 48° N. in summer (from October to September), nor 44° and 45° N. in winter (from October to March). The only drawback to the voyage is the fogs on the Californian coast, which are especially common from April to November. The land fall should generally be made to the northward of the destination.

A vessel making the great circle track to the eastward would have the great Japan stream in her favor to about 43° N. and 156° E., or about 1,440 miles; then the cold Bering sea current and the end of the Alaska current to 47° N. and 157° W., or 1,980 miles; finally to San Francisco, about 1,860 miles, passing through the great bend of the Japan stream, where so many indications of land have been recorded, and where the weather is almost invariably thick and bad in summer, and cold and boisterous in winter. On this track the summer winds would generally be favorable, and, with good weather, it would be altogether the desirable route; but with thick, foggy weather for nearly the whole of this distance, undetermined velocity and direction of the currents (except in general terms), great variability of climate to passengers and cargo, and extra hazard and risk to life and ship, some great positive advantage over all these must exist to warrant the adoption of it.

The commercial advantages of the steam route to China, through the warmer and more equable latitudes, must always outweigh any merely theoretical and shorter but more hazardous route. A study of the currents, winds, and weather on the lower latitude route will lead to the conclusion that is being solved practically. From the south end of Japan to San Francisco, a course very little north of a direct line on a Mercator projection carries a vessel across the great Japan stream, in part through the axis of the main branch flowing eastward, across the northern part of Fleurieus whirlpool, and across the California stream, with favorable or light winds the greater part of the distance."

Northern ports.—From 157° W. steer for the intended port or a little to the northward of it; the prevailing winds are fair.

CHAPTER VI.

ROUTES FROM THE PORTS OF OCEANIA.

§ 122. **Route from the Hawaiian islands to San Francisco and ports north.**—A ship starting from the Hawaiian islands should run north on the starboard tack for the westerly winds and then make her easting, approaching her port from the northward. From July to September she may have to run as high as 44° or 45° N., for the West winds, though they may be struck during the rest of the year, especially in winter, even before the parallel of San Francisco is reached. Fogs are very frequent on the coast throughout the year, and especially from April to November.

§ 123. **Route from the Hawaiian islands to Panama.**—The first part of the route is the same as that described for San Francisco in § 122. Vessels should not bear south until they have passed beyond the meridian of 138° W.; this will bring them into the NE. trades near 133° W. The voyage should be finished as described in § 68.

§ 124. **Route from the Hawaiian islands to Valparaiso and Callao.**—In making a passage from the Hawaiian islands to the coast of Chile or Peru, the best way is to stand across the trade as near the wind as the topmast studding sail will stand. This, as the direction of the wind is in general from ENE. to East, will enable you to make Tahiti, and pass the Society islands by one of the clear channels to westward of them. It is of little use trying to fetch to the eastward of these, as not only do you lose much time by hugging the wind too close, but also the strong current, which sets to the westward from 20 to 40 miles per day, is pretty sure to drift you that much to leeward; and even if this were not the case, so difficult, tedious, and dangerous is the navigation among the archipelago of low coral islands which lie to the eastward, that, unless you can weather the Marquesas altogether, it is better even to bear up than to entangle yourself in such a labyrinth. After passing the Society islands stand to the southward, till on or about the 30th parallel, when the westerly winds will be found. These will carry you into the coast, care being taken not to bear up when within the influence of the southerly winds till near enough to the land to insure keeping them down to your port.

§ 125. **Route from the Hawaiian islands to Europe.**—The first part of the passage is identical with that described in § 124. The West winds will generally be found near 35° or 40° S.; cross these parallels near 158° W., or more to the eastward if the trades allow.

Thence run to the southward and eastward as much as possible, so as to put your ship between 47° and 50° S. from October to April, and between 48° and 52° S. from April to October. Then run east until near 98°, or rather 93° W., and cross the parallel of the Diego Ramirez islands in the neighborhood of 76° W. This route is quite free from ice.

It should be understood, however, that a ship in great haste need not make such a detour as that above stated; but steer so as to reach the parallel of cape Horn at about 98° W. But the danger from meeting icebergs will be great on this route, and will necessitate a sharp lookout.

§ 126. **Route from the Hawaiian islands to New Caledonia and Australia.**—Vessels leaving the Hawaiian islands should shape their course so as to run out of the trades near 168° W.; and cross the line near 168° and 173° W. The track lies to leeward of the following low islands: Swallow (with a lagoon in the center); McKean (coral islands, about 20 feet above water); Gardner (an atoll, visible 15 miles, a few trees upon it); Mitchell islands, lat. 9° 27′ S., long. 179° 54′ E. (covered with cocoanut trees, and visible about 10 miles); it then runs west of Meek shoal; a good lookout is necessary near this coral bank, as the water does not always break over it. The South Pacific Directory for 1877 gives its position as 10° 40′ S. and 179° 08′ E. Its longitude, according to the French charts, is 178° 36′ E. Rotumah should be sighted and passed to the westward. There are two small islets about 2 miles north of this island; one of them is very low. The route also lies west of Hammond reef. Vessels bound to New Caledonia should sight Maré island and run through Havannah passages with the prevalent East and SE. winds.

If the wind should come out from West or even from NW. or NE., east of the pass, it will be better to give the isle of Pines and the Great reef a wide berth, and enter by Dunbea pass, as stated in § 112.

If bound to Australia, pass west of Mathew island; thence steer about WSW., and clear the great New Caledonian reef well to the southward. For the end of the passage, see § 139.

Between the equator and the south of New Caledonia a sharp lookout must be kept in that portion of the route. The winds in this locality are generally from East and SE. Occasionally heavy squalls blow near the New Hebrides and New Caledonia (§§ 4 and 26).

§ 127. **Route from the Hawaiian islands to China.**—Make your westing between 20° and 15° N.; keeping farther to the north in summer than in winter. Information concerning the latter part of the voyage is given in § 102.

§ 128. **Route from the Hawaiian islands to Tahiti.**—This passage presents certain difficulties, and should only be undertaken by vessels that can lie very close to the wind.

On leaving the Hawaiian islands you should stand south until in the latitude of the southern part of Hawaii, when you should haul your wind to cross the line, if possible, in the longitude of Tahiti, as the SE. trade breaks you off when you first make it, and then you do not fetch it within several degrees. It is tedious to get to the eastward in the latitude of Tahiti, owing to the strong westerly current; therefore, you should lose no chance of preserving your easting.

The most favorable time to make this passage is from the end of March to the 15th of June. But the most difficult season in which to reach the equator on the meridian of Tahiti is during the months of July, August, and September, when the SE. wind prevails, south of 10° N. During October, November, and December the direction of the wind will be a little more favorable; and in January, February, and March the wind will keep well to the northward and eastward until you reach the line. But navigators should always bear in mind that even in April, May, and June it will be difficult to fetch Tahiti without going about, unless with an exceedingly fine sailer.

If the ship be not weatherly, or is a very small auxiliary steamer, the better plan will be to run up beyond 30° N., on the starboard tack, and make the easting on that parallel; even half the allowance of coal may be usefully expended on this part of the passage. Sailing vessels will be delayed by calms and baffling airs unless they run well north, especially from July to November. They should, therefore, recross 30° N. at 153° or 150° W. if they can possibly do so, and then stand across the trades with the wind abeam, and try to reach 10° N. at 140° or 138° W. as soon as possible. If the wind then haul to the south they will be far enough to windward to fetch the equator to eastward of Tahiti.

Once south of the line they can take one of the passages through the north of the Paumotus, given in § 103.

§ 129. **Route from the Marquesas to the Hawaiian islands.**—This is not a difficult passage. Starting from the Marquesas a vessel should cross the equator as far east of 143° W. as she can with a clean full on the starboard tack. From the end of June till November the SE. trades usually blow as far north as 10° N. Later, and especially from February to June, the NE. winds reach nearly to the line; naturally this last season is the worst for a passage from the Marquesas to the Hawaiian islands. The chances of meeting calms near the equator in this locality are small; and the frequency of baffling airs from the west is certainly overdrawn by some authors. Information concerning the last part of this voyage can be found in §§ 95 and 99.

§ 130. **Route from the Marquesas to Tahiti.**—This is an easy voyage, with a fair wind all the way. It only demands attention near the Paumotu group and Tahiti.

The voyage from Nuka Hiva to Tahiti is generally accomplished in five or six days; course about SW. ½ S.; this brings you a little to windward of the central islands of Taiara and Raraka, to starboard of Faaite island, and then to windward of Anaa. Or, if deemed advisable, run between Toau, or Elizabeth island, and Aura, and then near Greig (Niau) island, sighting the lofty peaks Orohena, of Tahiti, rising about 7,360 feet above the horizon.

§ 131. **Route from Tahiti to San Francisco.**—Keep a clean full and cross the equator, if possible, on the starboard tack between 152° and 148° W.; or, in other words, as far to the east as the variable ESE. trades will allow. The best season is from the end of June till November, when the SE. trades reach nearly to 10° N. From February to June the NE. trades come well south toward the line. Few calms and usually a westerly current will be found. Run through the NE. trades on the starboard tack.

From June to November.—After crossing 10° N. well to the eastward, the starboard tack will fetch a ship to windward of the Hawaiian islands.

From November to June.—Advantage must be taken of every favorble shift in the wind that will set the ship to the northward and eastward; remember, however, that it is never well to lie too close.

The SE. wind inclines to the eastward near the equator, and to NE. to northward of the line. In order to make to windward of Hawaii, cross 10° N. near 148° W. If this cannot be done, run off and pass well to leeward of the Hawaiian islands, thus avoiding the calms near the group. For information concerning the beginning of the voyage, see § 136; for the last part, see § 122.

§ 132. **Route from Tahiti to the Gambier islands, Tubuai, Valpariso, Callao, and Panama.**—Ships bound to Valparaiso, Callao, and Panama should run for the region of West winds, as stated in § 110. These winds will usually be found beyond 35° S. With these winds vessels make to the eastward between the parallels of 35° and 45° S., and, if their port of destination be Valparaiso, approach the land to the southward, except during the season of Northers (§§ 29, 69 to 71, and 111). Vessels bound to the intermediate ports and Callao should not again enter the SE. trades until their port bears to the north of NE.; they should also make their landfall to the southward of their port. (§§ 69 to 71, 111 and 124). Vessels bound to Paita or Panama should not run into the trades until cape Blaco bears north of NE.; while those from Panama should sight cape San Francisco, and end the voyage as stated in §§ 48 and 55.

The following remarks by Captain Foy may be of interest:

"Every vessel bound from Tahiti to Gambier or Valparaiso, should double to the north point of Murea at a distance of 8 or 9 miles and pass to westward of that island. This precaution is necessary, as the mountains of Tahiti intercept the prevailing winds. Time will, therefore, be saved by keeping well off shore; still if the wind be from North or NW., she may take the channel between Tahiti and Murea, except from June to November, when the sea is heavy and the currents strong. This passage is 10 to 11 miles broad.

"Once clear of the group, steer about SSE., or even a little to the eastward of that point, as the current sets to west. Cross the meridian of Tubuai near 20° S., and stand on the same course to 22° S., thus clearing the doubtful low islands situated a little to the west of the meridian of Tubuai and beyond 22° S. Vessels bound to Tubuai should then head a little west of South; after running about 64 miles on this course, they ought to make the island off the lee (starboard) cat-head. At a distance, Tubuai resembles a 'ham.'"

§ 133. **Route from Tahiti to New Caledonia, New Zealand, and Australia.**—*Route to New Caledonia.*—As a general rule vessels should run north of the Tongas from July to October, and south from November to June. By making the following crossings the voyage will be easy and the wind fair:

In January, cross 18° S. at 160° W.; 22° 30′ S. at 175° W., or south of the Tongas; and make a straight wake for your port.

In February, run south of the Samoas, cross 17° S. at 175° W., and 20° S. about 178° W., then steer westward.

In March, 20° S. at 154° W.; 22° S. at 160° W.; and 22° 30′ S. at 175° W., south of the Tongas.

In April, 20° S. at 152° 10′ W.; 22° S. at 155° W.; 23° S. at 160° W.; thence pass north of Minerva reefs, and sight Fearn and Mathew islands.

In May and June, 15° S. at 152° W.; 13° S. at 155° W., and follow this parallel to 165° W.; thence run to southward of the Samoa group; cross 18° S. at 176° W., and pass west of the Tongas and south of the Fijis.

In July, 15° S. at 152° W.; 12° 30′ S. at 160° W.; 15° S. at 169° W., and run along this parallel to 180°; cross 18° S. at 174° E., and 22° S. at 170° E. This route carries the ship south of the Samoas, and north and west of the Fijis.

In August, 15° S. at 151° 10′ W.; 14° S. at 160° W., and keep on this parallel to 165° W.; 17° S. at 175° W., and 20° S. at 178° W.; in other words run south of the Samoas, north and west of the Tongas, and south of the Fijis.

In September, 18° S. at 160° W.; 21° S. at 170° W.; 22° S. at 175° W., and thence to the westward. This route lies south of the Tonga group.

In October, 15° S. at 152° 10′ W.; and follow this parallel to about 175° 50′ E.; thus passing south of the Samoas and north of the Fijis. Thence cross 22° S. at 170° E. Onaseuse, or Hunter island, can be sighted; it is situated in lat. 15° 31′ S., long. 176° 19′ E., and is a cultivated and inhabited volcanic island.

In November and December, 20° S. at 152° 10′ W.; 22° S. at 160° W.; and thence make the westing south of the Tonga group.

Afer making these crossings, as nearly as circumstances will allow, run through Havannah pass, with the prevailing East or SE. winds. But if to eastward of Havannah passage and the wind comes out West, NW., or even NE., give the isle of Pines a wide berth and enter by Dumbea passage, as stated in § 12.

The following observations on this route are by Captain Foy:

"After leaving Papiete for Noumea vessels run down their westing with the wind astern. They keep a good distance from Murea island, and leave the Borabora group on their starboard hand; thence they run through the Cook group. The principal island of this group is Aitutaki, and may be recognized by its remarkable hummock, which slopes to the southward. This island should be left well to port; still, if a shift of wind to west, or any other cause, should compel a vessel to run through the group, she can double Aitutaki to southward, keeping a good lookout for shoal water. Thence the route should be resumed, so as to profit by the trades. Tongatabu may be recognized by the shape of Eua, which is a round, large island with two summits; it is situated south of Tonga. Vessels may pass between these islands, or south of all. In the north channel the currents set toward the eastern coast of the island; while well off shore and south of Tonga their direction is westerly."

The length of the voyage is from sixteen to seventeen days, and the sailing distance about 2,475 miles.

Route to New Zealand.—From April to November pass north of the Tongas, and cross 17° S. at about 175° W. Thence, running to westward of the Tonga group, cross 20° S. near 178° W.

Make the westing on the parallel of 20° S., thus passing to southward of Batoubara (Vaturera) island; when steer SW., and cross the tropic near 178° or 177° E.; when the ship will probably meet the SW. or NW. winds, which will easily enable her to make the bay of Islands.

From November to April, after passing north of the Cook group, run south of the position of Bererage island, and cross the tropic at 173° or 175° W. Run to westward of the Kermadec isles, and thence for the bay of Islands, with the wind abeam.

The foregoing routes apply only to vessels bound to the bay of Islands. If bound to port Nicholson or Otago, it will be better to follow the route given for the passage to New Caledonia, and cross the tropic south of the isle of Pines; thence, after striking the West winds, run for Cook strait (§ 109), if bound to port Nicholson; or Favorite strait, if for port Otago.

Route to Australia.—Follow the track given in the first part of this section, under "the route to New Caledonia." Pass south of the isle of Pines and the Great reef; thence, run some distance to the west before standing to the southward. For information concerning the last part of the voyage, see § 139.

§ 134. **Route from Tahiti to China.**—From March to August, head about NW. to 3° or 2° S., and follow one of these parallels to 163° or 168° W. Thence bear north for the NE. trades. Keep to northward of the Ratack and Ralick groups. From May to October, steer from the north of the Marshall group for the south of the Marianas, keeping to northward of the Carolines, and enter the China sea through the strait of San Bernardino. (See § 101). The SW. monsoon prevails at this season.

From August to March, and especially after October, the route is a little more to the southward. It passes within sight of the Suwarrow islands, and runs north of the Samoas; thence steer NNW. and pass west of Duke of Clarence, Duke of York, and Gardner islands. Cross the line at 178° or 180° W., and keep east of the Ratack chain. After doubling these islands to the north, pass between Grigan and Assumption, or rather north of the Marianas (§ 101), and enter the China sea to northward of the Bashee group. The NE. monsoon prevails at this season.

§ 135. **Route from Tahiti to the Marquesas islands.**—This passage, though quite difficult under canvas, can, with the assistance of steam, be rendered comparatively easy. Vessels could easily fetch Nuka Hiva if the Paumotu group were not in the way. As it is, they should be very careful if compelled to go about in the middle of the group. An auxiliary steamer should always enter through the strait between Fakarava (Faarava) and Faaite islands; keep to windward of Raraka and Taiara, and leave the group by running to windward of Tika (Tikei). From this point it is generally possible to fetch Nuka Hiva.

The approach to the Marquesas being simple, the delicate part of the route is that through the Paumotus. The wind in the western part of the group is generally from NE., and in the eastern part from SE., though variable in both instances.

After leaving Tahiti and doubling Venus point you should lie very close and take advantage of every shift in the wind, and if lucky, you will be able to run through the passage between Fakarava and Faaite the next day at daylight. If possible keep to windward of Raraka and Taiera islands, and leave the group by passing to windward of Tikei, if the wind incline to shift to SE. or ESE. But if the wind freshen from ENE. to NE., it will be difficult to make easting, as the current sets west, or very often south, so strongly that it will be difficult to make headway against it, in which case you will be compelled to cross the Paumotus between Vliegen (Nairsa) and Arutua islands, and if possible run out to windward of Manihi island.

Once clear of the Paumotus, beat to eastward as far as possible, as northing can be made at any time, especially if the SE. trades be found north of the largest of the Napuka group. Make the land at Roa Poa, which lies south of the principal island, and thence run for Taiohae bay, where there is an anchorage in from 7 to 9 fathoms. The harbor is sheltered, except from SW. and South.

This passage can generally be made in fifteen or sixteen days, and the weather, especially among the islands of the Paumotu group, will be quite bad.

§ 136. **Route from Tahiti to the Hawaiian islands.**—The reader should first refer to § 131, where, speaking of the route from Tahiti to San Francisco, we stated that, from June to November, vessels could easily fetch to windward of the Hawaiian islands if they crossed 10° N. at 148° W. During the rest of the year it will be difficult to cross the 10th parallel so far to the east, and almost impossible to make Hawaii.

After passing Maitea endeavor to get to the eastward and to cross the equator in about 150° W. longitude, so that when the NE. trade winds are met you will be well to windward. There is otherwise some difficulty in rounding Hawaii, which should be done about 40 miles to the eastward to insure the breeze. The passage between the Society and Hawaiian islands differs from the navigation between the same parallels in the Atlantic, in the former being exempt from the long calms, which sometimes prevail about the equator, and in the SE. trade being more easterly. The westerly current is much the same in both, and if not attended to in the Pacific will carry a ship so far to leeward that by the time she reaches the parallel of the Hawaiian islands she will be a long way to westward, and have much difficulty in beating up to them.

§ 137. **Route from New Caledonia to San Francisco.**—Use the instructions concerning the first part of the voyage, in § 109 (Cape Horn route). Vessels should double New Zealand to northward, and bear away for 48° or 50° S., keeping on this latitude until they reach about 138° W. Thence the track is to northward and eastward, and enters the SE. trades near 128° W. Finish the voyage as stated in §§ 50 and 111, or by the route through the islands (§ 111) all the way.

§ 138. **Route from New Caledonia to Valparaiso, Callao, and Panama.**—§ 109 also contains instructions for this passage. After passing north of New Zealand vessels gradually make to the southward and eastward. From October to April they run down their easting between 45° and 50° S.; from April to October, between 47° and 52° S. The voyage is generally ended as stated in § 111.

§ 139. **Route from New Caledonia to Australia.**—This is a voyage of fair winds. In order to meet them a ship should first steer for Sandy cape, and then round off to the southward so as to reach the parallel of Moreton island, near 157° E. The course is afterward south, with variable winds and a current generally favorable. The land should be made to northward of the port.

The passage to Moreton bay, Newcastle and Sydney can always be made with fair winds from December to May. The route is direct, but as the current sets to the southward, it is best to head for the land at least a degree to the north of your port. Once in sight of land of course your future action will depend upon the direction of the prevailing winds. The approach to the coast is rendered dangerous by the frequency of the heavy wind and rain squalls from ESE. to ENE. They rarely last for more than two or three days. It is then advisable to keep well off shore until the weather changes. When bound to Newcastle the land should be made near port Stevens.

The heavy squalls mentioned are those referred to in § 6.

§ 139. **Route from New Caledonia to Singapore, China, and Japan.**—Starting from Noumea, bound to Batavia and Singapore, during the SE. and SW. monsoons, from April to October, a ship should, as soon as the passes are cleared, head NW., and then run east of Fairway reef. Thence, with the SE. trades fair, the route lies to northward; giving Bampton and Mellish reefs and Diana bank a wide berth. Run through Torres strait, and finish the voyage as stated in § 175.

Bound to Saigon or Hongkong, between March and the end of July, take the same route, with the SE. monsoon after you. Cross the Java sea and enter the China sea through Carimata strait. Here the SW. monsoon prevails, and lasts till the end of October. For information concerning the end of the passage, see § 177.

During the NW. and NE. monsoons, from October to April, sailing vessels, and auxiliary steamers wishing to save coal, should take the northerly route for Hongkong, Saigon, and Singapore. Auxiliary steamers carrying enough coal to make the passage from Noumea to Kupang, a distance of 2,700 miles, can take the Torres Strait route. The anchorage at Kupang is tolerably good at this season. The route from Kupang to Batavia passes through Lombok and Madura straits; thence the passage is direct for Singapore. Vessels will be compelled to steam nearly the whole time.

But, as already stated, the northerly route is preferable for sailing vessels and auxiliary steamers. Once to eastward of Fairway reef, stand to the northward, and pass between the Solomon and Santa Cruz islands. From this point there is a choice between two routes.

If bound to Hongkong or Saigon make to the northward, and cross the line between 162° and 166° E. The track passes a little west of Kusaie, or Ulan, island (Carolines), and either east or west of the Providence isles, according to the circumstances; keep north of the Marianas, or between Grigon and Assumption, and enter the China sea by the passage north of the Bashees. For further information, see § 177.

There is but one route to Yokohama. Pass to westward of the

Volcano group and cross 30° N. a little west of the meridian of your port. Navigators should recollect that the Kuro Siwo sets to NE. (§ 37.)

Vessels bound to Singapore can keep to the eastward of the Solomon islands, and then skirt them either to north or south. They should leave New Iceland to the southward, and enter the Celebes sea by passing between the Serangani islands; reach the Sulu sea by Basilan strait, and the China sea by Balabec strait. Thence to Singapore they should follow the return route to that given in § 155 for going from Singapore to Palawan passage. Useful instructions concerning the first part of this voyage will also be found in § 177.

§ 141. **Route from New Caledonia to Tahiti.**—This is a difficult route for sailing vessels. For information concerning the first part of the voyage, the reader should refer to § 109; we would especially call attention to the instructions for doubling New Zealand to the northward.

The meridian of North cape or that of the bay of Islands once passed, the difficult portion of the voyage is over. Vessels should stand to the eastward with the prevalent though variable West winds. No rule can be given as to where a ship will strike these winds, as they are liable to be found on very different parallels, even during the same season. However, it will generally be the best plan to make the following crossings:

In January cross 35° S. between 178° E. and 178° W.; follow 36° or 37° S. from 178° W. to 163° W.; cross 35° S. at 155° W.; 30° S. at 151° W.; 25° and 20° S. near 149° W.

In February follow 36° or 37° S. from 178° W. to 150° W.; cross 35° S. at 148° W.; thence make the northing to 25° S., and steer for Tahiti.

In March follow 35° or 36° S. to 158° W.; and thence steer so as to reach the tropic near 149° W. The SE. winds will often allow this route to be followed.

In April the South winds will frequently enable vessels to run north of the Kermadec islands. They should afterward cross 30° S. at 168° W.; 31° S. at 163° W.; 30° S. again at 153° W., and thence running east of Tubuai for Tahiti.

In May vessels usually pass north of the Kermadec group with the South winds, which then incline both to the eastward and westward.

There is no need of running into a higher latitude than 28° S.; cross 25° S. near 158° W.; pass between Rurutu and Tubuai; cross 20° S. near 149° W.; and thence for Tahiti

In June, the same route. After running down the easting on 28° or 27° S., cross 26° S. near 158° W.; and thence head for Tahiti.

In July vessels will usually be compelled to pass south of the Kermadec group; and thence steer directly for 27° S. between 154° and

156° W.; after crossing 25° S. near 151° W., they should run east of Tubuai.

In August, the Kermadecs can easily be cleared to southward; thence the track reaches 30° S. between 153° and 155° W., and runs to eastward of Tubuai.

From September to January, pass to southward of the Kermadec group. In September, keep between 32° and 33° S. until you reach 153° W.; cross 25° S. at 149° or 150° W., and run east of Tubuai. In October, reach 34° S. as soon as possible and at about 180°; and keep between 34° and 35° S. until across 166° or 164° W.; cross 30° S. between 153° and 154° W.; sight Tubuai; and make 20° S. near 150° W. In November, the same route on 34° S. to 160° W.; cross 30° S. between 152° and 153° W., and pass to windward of Tubuai. In December, a ship can reach 35° S. between 175° and 177° W., and thence keep between 36° and 37° S. until she is near 152° or 150° W.; she should cross 35° S. at 148° W., and 30° S. at 146° W., passing either east or west of Lancaster reef, according to circumstances; to eastward of Vavitao; and then heading for Tahiti.

As already stated in § 109, the worst months for doubling New Zealand are those between September and February. Voyages will usually be long at this season; still a good sailer can generally make the passage from New Caledonia to Tahiti in from fifty to fifty-five days.

We can also conclude from the foregoing facts that the NW. monsoon only prevails in the western part of the south Pacific, to the northward of New Caledonia. On the contrary, south of 20° S. the SE. trades, though variable, exist during the entire year, their southern limit following the declination of the sun the same in these localities as elsewhere.

Captain Richard Foy remarks as follows on this passage:

"Setting sail from Noumea you will first have the wind abeam, and as soon as you have cleared the small pass, well abaft the beam, take the SW. outer pass; leaving Prony ledge to port or to windward, and the Signal island to starboard. Once outside, brace up and make for the variables. Vessels generally keep between 30° and 36° S., but sometimes have to run as far south as 40° in search of the West wind, when they again bear to the north and sight Kemin island; or the tropic can be crossed near 158° W. Approach Murea, and then go about for Tahiti. The average length of the passage is forty-two days, the worst part being between 30° and 36° S."

§ 142. **Route from New Caledonia to New Zealand.**—The length of this passage is quite variable, and the route differs according to the port of destination.

Vessels bound to Auckland should set the course as if they were going to Tahiti (§ 141), or should follow the instructions concerning the first part of the voyage to Europe (§ 109).

By referring to § 109, it will be seen that from September to February advantage should be taken of every shift in the trades, in order to make as much to the southward and eastward as possible. It will probably be found difficult at this season to reach the meridian of the bay of Islands; but from March to July vessels can commence to make easting soon after leaving Noumea, and can run to the southward at any time.

Vessels bound to port Nicholson or Otago should run south, rapfull, with the East winds, and when they have reached the prevalent West winds, still keep to the southward, being careful not to get too close to the west coast of New Zealand. They should take Cook strait if bound to port Nicholson, and Foveaux strait if bound to Otago. (See § 107).

§ 143. **Route from New Caledonia, or the Fijis, to the Hawaiian islands.**—On leaving New Caledonia, a ship should follow the instructions given in § 109. It will not, however, be necessary from November to March to run lower than 36° or 38° S., and only to 33° or 35° S. from March to November. Pass either north or south of the Kermadec islands, according to the season, as stated in § 140, and do not bear to the north until 135° or 134° W. is reached. The course should be laid so as to pass south of Pitcairn island, and thence east of the Paumotus and Marquesas; head to strike the NE. trades between 5° and 10° N. and 133° and 138° W. From this point the route is easy if you are careful to keep to windward of Hawaii (§§ 129 and 136).

If the point of departure be the Fiji or Tonga islands, take the southerly route just described. Run through the SE. trades on the port tack; the West winds will generally be found near 30° S. Strike the SE. trades again to eastward of the Paumotus. This is the shortest and surest route.

Vessels can also run through the SE. and NE. trades on the starboard tack and make their easting near 30° N. This is the preferable route for vessels leaving the Tongas between October and March, and always the best for ships from the Samoas.

§ 144. **Route from New Zealand to Europe.**—*The Cape Horn route.*—Once to eastward of the group, steer as nearly SE. as the wind will allow, and gradually bear away for the parallel on which you wish to make the easting; keeping north of 50° S. from October to April; and north of 52° S. from April to October. For information concerning the end of the voyage, see § 108.

The Suez route.—Small auxiliary steamers will find it to their advantage to take this route, provided they leave New Zealand after the 15th April and before the 15th July. They should run to the north for the SE. trades, which they will find a little south of the tropic, thence pass south and west of New Caledonia and head for Torres strait. For particulars concerning the remainder of the voyage, see § 109 (2d part) and § 140.

The route south of Australia can only be followed by large ships. There will be no advantage in taking this route during the southern summer even if bound to one of the Mediterranean ports, as vast quantities of coal will be consumed, and the toll through the Suez canal is heavy.

§ 145. **Route from New Zealand to the western coast of America.**—Once clear of the land steer to the southward and eastward, as stated in § 111.

§ 146. **Route from New Zealand to New Caledonia.**—Starting from Otago, port Nicholson, or Auckland, a vessel should make to the north along the eastern coast of New Zealand as the weather is always bad off the western coast (§ 8). She should run west of the Kermadecs, if the winds allow. From September to February the SE. trades will generally be found near 30° S. During the remainder of the year they do not come much below 25° S. Havannah pass is the best entrance with the prevalent East to SE. winds.

A sailing vessel approaching Havannah pass and finding the wind from West or even from NW. or NE. should give the isle of Pines and the great reef a wide berth, and run in through Dumbea pass, being first careful to get well to SW. of the light on Amédée islet (§ 111).

The passage from New Zealand to New Caledonia can be made in eight days, if you take advantage of every shift of wind, especially in the trades. The latter are often met at 26° or 25° S., that is, long before a vessel enters the tropics.

§ 147. **Route from New Zealand to Australia, Singapore, and China.**—From Otago, port Nicholson, or Auckland, and bound to Moreton bay or Sydney, vessels should keep east of New Zealand, as stated in § 111. Having reached the East wind near 25° S., they should run to westward, and finish the passage as stated in § 139.

If bound from Otago to Melbourne, we think that it will also be advantageous to keep north of New Zealand and run to the northward as far as 30° or 25° S.; and thence to run down the east coast of Australia and through Bass strait, as indicated in § 182.

This route is about twice as long as the one by the south of New Zealand, but quicker and easier. But captains deciding to run through Foveaux strait will have to wait for an East wind (rare in this locality), and even if they are lucky enough to carry it through the strait, they may meet a gale from NW. a few miles to the westward (§ 8), in which case they will have to put back through the strait to the eastward.

Navigators deciding to pass south of Stewart island must look out for the Traps and Snares. Between Stewart island and Tasmania the current and wind will both be contrary. The weather is, however, a little better during the southern summer.

To China and Singapore.—Vessels should at first follow the instructions given in § 146; then those in § 140. The reader should also refer to the easterly routes given in §§ 175 and 177; one of these passes to east and the other to west of New Caledonia, and a third through Torres strait.

§ 148. **Route from New Zealand to Tahiti and the Hawaiian islands.**—*To Tahiti.*—After a vessel is once well to the eastward of New Zealand she should steer for 30° S. near 153° W. from April to November; and for 30° S. near 150° or 148° W. from November to April. Thence the track passes between Vavitao and Tubuai; it is best to sight one of these islands, whichever may be most convenient, and to make the northing so as to fetch to windward of Tahiti (§§ 93, 94, and 141).

To the Hawaiian islands.—The parallel on which to make the easting will depend on the latitude of the port left. The attempt should be made to reach 30° S. between 135° and 133° W. Consequently a vessel should commence to make northing when this crossing bears ENE. or NE. The SE. trades once reached, pass east of the Paumotus and the Marquesas; and strike the NE. trades in the region between 133° and 138° W. and about the parallels 5° and 10° N.; thence to windward of Hawaii (§§ 95 and 136).

CHAPTER VII.

ROUTES FROM EUROPE TO CHINA AND RETURN ROUTES.

§ 149. **Showing under what circumstances the Suez route is preferable to and from China.**—The reader should refer to the second part of §§ 105 and 108. We will here begin a résumé of all the instructions that relate to the China voyage.

The route to China.—It is understood, of course, that the Suez route is not practicable for sailing vessels, for, independently of the long Mediterranean passage and the cost of transit through the canal, they can only descend the Red sea from April to October. If they should clear the Red sea about the end of May they will find the SW. monsoon north of the equator in the Indian ocean, and can reach Singapore during the first days of July, and run up the China sea with the SW. monsoon. At no other season should this route be taken; and we can hardly advise it for sailing vessels, even if they leave one of the Mediterranean ports of France in March or April.

The best route to China for mail and auxiliary steamers starting from Marseilles is by the Suez canal. From March to June is the most favorable season, and a vessel will then find North winds in the Red sea; and the SW. monsoon north of the equator in the Indian ocean and the China sea.

From October to February ships are liable to be detained by strong head winds in the Red sea, and will use up all their coal if the attempt be made to steam against the NE. monsoon of the Indian ocean. They should therefore run south of the line for the winds known as the NW. monsoon; these are, however, no others than the SE. trades, which are interrupted at this season and vary to South, SW., West, and NW., accompanied with rain and squalls. In the China sea the NE. monsoon will be found.

The route from China.—Sailing vessels should not attempt to reach Europe via Suez, as the North wind prevails nearly the whole year round in the lower two-thirds of the Red sea.

Steamers and auxiliary steamers wishing to take the Suez route should leave Yokohama about the end of October, and Hongkong in November. They will have the NE. monsoon in their favor, and after running through the strait of Malacca, should cross the Indian ocean north of the line. From October to April, and especially in January and February, the wind is generally from the southward in the southern part of the Red sea; but north of Jebbel Teer, steam will have to be used against the head wind. Voyages at this season are comparatively safe, rapid, and economical.

Vessels leaving China or Japan after the month of April will have to steam against the SW. monsoon of the China sea. This is also the season for typhoons.

After passing through the straits of Sunda they should run down their longitude in the Indian ocean, by keeping south of the line, with the SE. trades well abaft the beam. In the Red sea the wind will be ahead all the way to Suez. The voyage therefore at this season will be long and expensive.

§ 150. **Route from Europe to China.**—During the SW. monsoon, from April to October. Instructions relative to this route will be found in the "Navigation of the Atlantic Ocean." The reader should also refer to § 105 of the present volume.

The Indian ocean once reached, run down the easting between 43° and 46° S., keeping in a higher or lower latitude according to the weather. (Consult § 104.) Thence steer NE. so as to cross 40° S. between 80° and 84° E. The SE. trades should be struck north of 30° or 28° S., and the tropic of Capricorn crossed near 102° E. According to Horsburgh vessels should then head for the strait of Sunda, being careful to make the meridian of Java head several degrees to the southward of the island and then run north. In March, April, and May, the prevailing winds haul to the eastward, making a westerly current along the south coast of Java; this fact will necessitate keeping well to windward, and making the landfall near Klapper point. From April to October, or the season of the SW. monsoon, the China sea should be entered by Banka or Gaspar strait. If going to Singapore, Banka strait will be preferable, when the winds are light and unsettled, as the approach to this passage is easy and a ship can anchor anywhere. Stanton channel is generally considered the best; it runs along the SW. coast of Banka; is 19 miles long and 3 miles broad in its narrowest part. The depth varies from 7 to 20 fathoms in mid-channel. At the SE. extremity the depth is 7 fathoms and 20 at the other. Once through, head for Rhio strait.

With a fresh, steady wind vessels should take Gaspar strait. The approach to this strait is dangerous in thick or bad weather, and the water very deep.

Sailing vessels bound to Singapore can also cross the line in the Indian ocean at 90° or 92° E., thence they can head to double Sumatra, with the SW. monsoon, and take the strait of Malacca.

If bound to Saigon.—Vessels taking Gaspar strait should cross the line near 105° E. If they take Banka strait, they should pass between Taya and Toejoe islands, and thence lay a course to cross the equator at 105° E. Once past the line the course is for pulo Aor, keeping well clear of Frederic bank, and to eastward of the reefs lying off Bintang. After leaving pulo Aor finish the voyage as stated in § 154.

When bound to Hongkong there is a choice of three routes: the inner route, the outer or deep sea route, and the Palawan route.

Inner route.—On leaving Banka or Gaspar straits in February, March, or April, vessels should take the inner route; to follow it they should first steer for pulo Aor; and thence keep along the coast of Cochin China, passing west of pulo Sapatu and the Paracels. Although this is the best route at this season, the passage will probably be long and tedious under canvas. Complete instructions for the inner route from pulo Aor to Hongkong will be found in § 155.

Outer route.—A ship running clear of Banka or Gaspar, between the end of April and the beginning of September, will find the outer or deep-sea route preferable. In this case she should steer to pass a few miles to the east of pulo Aor, and finish the passage in accordance with the instructions given in § 155; passing east of pulo Sapatu, the Catwicks, and between Bombay reef and the Macclesfield bank. In order to follow this route pulo Sapatu must be made before the beginning of October.

Palawan route.—A ship running clear of Banka or Gaspar during September and October should take the Palawan route. Coming from Banka strait, cross the line near 105° E., as before stated. Thence steer to pass south and east of Barren island; thence east of Low island and Hutton reef, and run between the Anambas and Subi islands. Coming from Gaspar strait, during September and October, shape the course a little to the eastward of St. Barbe island; thence head for the passage to the east of the Tambelan islands; rejoin the route south of Low island and Hutton reef, and pass between the Anambas and Subi. For information concerning the termination of the route, see Palawan route in § 155.

§ 151. **Route from Europe to China.**—During the NE. monsoon, from October to April. Instructions relative to this route will be found in the "Navigation of the Atlantic;" also § 105 of the present volume. The Indian ocean should be crossed between 43° and 45° S. This is the season of the southern summer, and a ship can run as far south as 46° or 48° S., before meeting cold weather. The parallel of 40° S. should be crossed between 90° and 92° E.; 30° S. between 105° and 107° E.; thence the track is through the trades for 20° S. near 112° E.; and for either Bali or Lombok, Allas, or Sapi straits, as may be thought best.

There is a choice between three routes at this season, viz: The first, by Makassar strait, can be followed in October, November, and March; the second by Pitt passage, is the surest, especially from the beginning of December to February; the third passes around the south of Australia, and is very little used. It is advantageous for vessels bound to Shanghai and Japan.

The route to Hongkong by Makassar strait.—This route should only be taken in October, November, and March. After crossing 20° S. near 112° E. any one of the following straits may be taken, viz: Bali, Lombok, Allas, or Sapi. The first two are generally preferred.

A ship taking Bali strait in September and October should bear north and pass between Sapoedie and Giliang, and afterward give a wide berth to the Kalkoen reefs and islands, situated north of Kangeang, passing them to the westward; pulo Laut may be passed on either side, as circumstances allow.

The Lombok Strait route seems to be the best from the 15th January to the 1st March. Vessels should keep in the midchannel, between Pandita island on the west and Lombok island on the east, and afterward to the eastern side of the strait. Once out of this strait the course is NNE. for that of Makassar, the track passing between the most western island of the Pater Noster group and Hastings island. After sighting Hastings, head to northward for the Two Brothers and great pulo Laut.

Vessels choosing Allas strait, should, when clear of it, head NNW., and afterward north for Hastings island. After running east of it they should finish the voyage as if coming from Lombok strait.

On arriving from Sapi strait during the months of September and October, a ship would, according to the prevailing winds, pass to the east or west of the Postillions, and proceed to the north between Tanakeke and the Tongu islands; then pass at a good distance the isles and banks of Spermonde, and enter Makassar strait near the Celebes coast.

The route through Makassar strait.—The Pater Noster islands divide this strait into two passages. The west channel is from 30 to 33 miles broad, and the east channel from 45 to 48 miles. The first is the most frequented, notwithstanding its dangers, as the depth of the water is less on the coast of Borneo, and vessels can anchor all the way to 1° N. In October and November the winds are exceedingly variable in this channel.

In the east channel there is no anchorage on the Celebes coast, as the shore is steep-to all the way up the strait; however, this seems to be the better passage in October and November, when the wind is light from the southward.

A ship coming from Sapi strait should take the east channel of Makassar strait; and from cape Mandhar to cape Rivers, follow the Celebes coast, keeping from 6 to 9 miles off the land, if the wind be light. But a vessel beating up against a head wind and current will have to approach the coast much nearer at times, especially in the bay south of cape Temoel.

Vessels coming from Bali, Lombok, or Allas strait, and wishing to take the west channel through Makassar strait, should double great pulo Laut to the SE., passing either east or west of the Alike islands, and thence steer for Shoal point. If compelled to beat they should stand on the off shore tack until 12 or 15 miles from the coast, and in 14 or 16 fathoms of water; then go about and stand in until about 6 miles from shore, and in 7 or 8 fathoms.

There is generally a southerly current in Makassar strait. It is violent in January and February, and moderates in March. It sometimes sets to the northward in October; this is, therefore, the most favorable month for going to China by this passage.

After having passed through Makassar strait, from September to the beginning of December, and especially in September and October, run into the Pacific, between Celebes and Mindanao, and then head for Hongkong; but in March it will be too late to take Pitt strait, or to enter the Pacific between Celebes and Mindanao, and the remainder of the voyage will have to be accomplished by running to westward of the Philippines. We, therefore, have the two following routes:

First route from Makassar strait.—A vessel clearing Makassar, from September to the end of November, should enter the Pacific by steering from cape Rivers to Sangir or Siau, and thence north of Morti. After passing between Siau and Tagulanda, or through one of the adjacent passages of Sangir, Horsburgh advises an east course, so as to round the northern extremity of Morti. If the wind come out from NE., and the current be southerly, after passing south of Siau, the ship will probably be drifted within sight of Gillolo or Morti, and, perhaps, Mayo and Tifori islands. The southerly current generally ceases near these islands, and sets north along the west coast of Gillolo. Still it is best to give Morti and Gillolo islands a wide berth when doubling them to the northward, as the southerly current, combined with the NE. swell, may sag the ship too close to the shore. After doubling Morti island (and always according to Horsburgh) do not go beyond 4° N. to make the easting, as the West or variable winds appear to be dominant in low latitudes. On the contrary, if a ship runs into a higher latitude she will strike the NE. monsoon. At the commencement of this monsoon—that is, at the season when this route should be followed—a vessel should keep south of 4° N., until the Pelew islands can be doubled to the eastward, and then bear north. In case of doubt it will be best to sight the most southern one of these islands, and then run up to westward of the group. In November, December, and January the wind is generally strong, and from the NE., between the Pelew islands and Luzon; and, as the currents also set to west, it is necessary to make plenty of easting, in order to clear the north point of Luzon and the Babuyans. As the wind and current are less violent in February and March, it will be safe to pass west of the Pelew islands.

As an indorsement to this last observation we will quote, a few pages further on, the opinion of Captain Polack, who advises vessels leaving Gillolo passage not to lose time making to the eastward, but to bear north immediately, and keep along the coast of Luzon. According to this navigator it is useless to go toward the Pelew islands, unless for North winds. But we would draw the reader's attention to the fact that Captain Polack's observations refer to the passage from Gillolo to Bashees, which is generally made in January, February, and March, when Horsburgh himself maintains that the west currents and NE. winds are more moderate, and adds that "vessels may pass west of the Pelew islands."

Second route from Makassar strait.—On clearing the strait of Makassar in March and April a ship should pass west of the Philippines; and, after leaving cape Dondo, steer for the east extremity of Basilan, being careful that the westerly current and East winds do not drift her upon the Sulu chain of islands.

In Basilan strait keep close to the coast of Mindanao, thus avoiding the shallow water off the Santa Cruz islands. By following this advice a ship can anchor, if necessary, off Samboangan or on the coast of Mindanao, when she will have nothing to fear but the fishing stakes, as the dangers are well beaconed. The tides are here alternately strong and weak; the currents are generally very strong, and set sometimes to east and sometimes to west, changing suddenly from one direction to the other.

Stand to the northward from Basilan, and keep near to the west coast of Mindanao, Negros, Panay, Mindoro, and Luzon. While coasting these islands, from November to April, variable land and sea breezes will probably be experienced, although the direction of the dominant wind is North.

Between Mindanao and Negros, and between Panay and Mindoro, look out for the strong NE. winds and west currents, which sweep through these passages, and may drift the ship near the Cagayanes. Being abreast of Balagonan point with a steady SW. or South wind, steer a direct course for Naso point, keeping a little to the eastward. If the winds are unsettled, light, and variable, keep along the coast of Mindanao to Galera point, or thereabout, prior to stretching off from that coast for Naso point; and, in crossing, endeavor to approach the west coast of Negros island. On leaving Panay, head the ship for Ilin and Ambolon islands, and give a wide berth to the Buffaloes and the sand bank off the Semirara islands.

When within 18 miles of Ambolon and Ilin islands stand to the westward, and keep 12 or 15 miles from that coast until the southern extremity of the islands bears SE. by E. ½ E. Double the reefs lying west of these islands to the northward, and approach Mindoro if the ship is to take the east channel between Mindoro and Apo shoal. Keep about 6 miles from the islets off Pandan point, especially during the night; the east extremity of Apo shoal being narrow and difficult to see if the wind is from the West. There are no breakers over the shoal.

The west channel of Mindoro strait is known as Northumberland passage, and is, perhaps, the better. It is from 15 to 18 miles broad. A vessel can here sight the Apo islands, and, if deemed advisable, run within a mile of the west coast of the largest of this group.

Route to Hongkong by Pitt passage.—This route should be taken from the beginning of December to February. Pitt passage is between Mangola and Obi Major on the north, and Bouro and Ceram islands on the south. It has three communications with the Pacific, viz: Gillolo strait, between Gillolo and Waigiu islands; Dampier strait, between Waigiu and Batanta; and Pitt strait, between Batanta and Salwatti. Vessels coming from Europe should ordinarily take Ombai strait, leaving Sandalwood island to north, and thence running between Timor and Ombai, pass the eastern extemity of Ombai, stand north close hauled on the port tack, with the NW. monsoon, and thus endeavor to double Bouro to windward; that is, to westward. If they do not fetch to windward, the passage east of the island and west of Manipa can be used. Thence head ENE. so as to pass east of Obi Major, and through Gillolo or Dampier strait. This route can be followed after the 15th November, and is probably the best during December, January, and February. Pitt strait, between Batanta and Salwatti, is rarely used.

Gillolo strait is to be preferred toward the end of November and during December, as the NE. wind is not then very fresh in that locality. It can also be taken in March when the NE. winds begin to moderate. It is broader than Dampier strait, and the shore near the islands is clean and steep-to, enabling a ship to beat through at night. The currents are rarely strong. As the NE. wind is often fresh in Gillolo strait during the months of January and February, and the Pacific swell heavy, it is best to take Dampier strait, where the wind is sometimes variable and favorable. But it should be remembered that there are in this locality several dangers lying in deep water; that the tides are very strong, and that vessels should keep close to Pigot point, so as not to be set toward the coast of New Guinea.

After passing east of Obi Major (in December and March) steer so as to double the southern extremity of pulo Gasses very close aboard; while passing between pulo Gasses and Kekik remember that the current often sets to east. After doubling the former island the highest of the Dammer isles will come in sight (at a distance it has the form of a saddle); thence run between Gebi island and Tabo point (Gillolo). Look out for Fairway ledge and the Weeda islands if this passage be made during the night. As the currents often set to NE. and East, keep on the west side of the channel if the wind be light. If the wind be NNW. and the vessel can not double Gebi to northward, pass between it and Gag, and run into the Pacific, leaving the Siang islands to the eastward, if possible. If unable to double the Asia islands to northward, run between them and the Aiu isles; if absolutely necessary the passage between the north coast of Waigiu and the Aiu islands can be taken. Thence steer East, keeping south of 3° N., and between 1° 30′ and 2° N., if possible, until the ship reaches 136° E., when let her run east of the Pelew islands from October and December, and close to the westward of them from January to March. Horsburgh thinks that there are North and NW. winds and South and SE. currents between 1° 30′ and 2° N. Beyond 3° N. the winds are from NE. and the currents set to east, and even to the northward of east. When the NE. monsoon is well settled they sometimes set to the westward.

The Dampier Strait route is taken in January and February. Once to the east of Gomono shape the course for the passage between pulo Popa and the Bu isles. There is also a good passage south of pulo Popa, and between it and the Kanari isles.

If the wind be from NW., the passage north of pulo Popa is the best. To follow it, round the low chain of islands* situated NW. and WNW. of cape Mabo. When this cape bears south keep 9 miles from Batanta, and do not let Pigeon island bear to east of ENE., as there are banks along the north coast of the channel. When 9 or 12 miles NE. of Fisher island the ship will be on soundings, but the bottom off the Batanta coast is foul, and if compelled to anchor till the tide turns use a stream anchor or a kedge. When standing along the west coast of Batanta, at a distance of 8 or 9 miles, steer NE., keeping Augusta bearing nearly NE. by E. If Mansfield island is visible keep it nearly in range with the southern point of Fowl island, and run south of all the shoal water.

When Augusta island bears N. by E., distant 4 or 5 miles, steer a little more to the northward, and pass 2 or 3 miles south of Pigeon island and keep well to west and north of Vansittart shoal. To clear it the ship must be more than 4 miles from Fowl island, when she raises it between East and SSE. Then lay an East course and keep north of a line joining Fowl and Mansfield islands.

A ship clearing Dampier straits in December and January will be exposed to heavy northerly squalls and an accompanying swell. It is, therefore, best to keep within 2 or 3 miles of the small islands off Pigot point; then keep Pigot point, or the islet close to it, bearing west of SW. by W. ¼ W. until they are out of sight. By following this precaution Buccleugh shoal will be avoided. Thence head NE., if the wind permit, and clear the coast of New Guinea well to windward.

According to Horsburgh, vessels wishing to pass east of the Pelews should run east between 1° 30′ and 3° N. until near 136° E. A good weatherly ship can, however, even in November and December, pass close to westward of the group. Between the Bashees and the Pelews the current is generally westerly, with a speed of from 10 to 15 miles per day; the wind NE. and the sea heavy, especially in December, January, and the beginning of February. Near Luzon, the Bashees, and Formosa, typhoons are rare after the month of December. In February and March a vessel can easily run west of the Pelews and weather the northern point of Luzon, as the trades often haul to ENE.

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*Probably the Tameai isles.—Translator.

The end of the voyage.—The northern extremity of Luzon once cleared, take any of the channels between the Babuyans and Bashees, except at the beginning of the monsoon, and when the winds are from NE., in which case run north of the Bashees and either north or south of Gadd rock. In clear weather and in the daytime vessels pass between the south point of Formosa and the Vele Rete rocks. Between Formosa and China the prevailing wind is northerly. But during the night or in bad weather the Bashees must be doubled to the northward and the ship kept well south of the Gadd and Vele Rete rocks. In all cases try to sight Pedro Branco or the China coast and keep the lead going during the night. Enter Canton river by the Lema channel.

We give below the observations of Captain Polack, commanding the barque *Esmeralda* (Ann. Hydr., vol. 23). It will be noticed that his advice differs materially from Horsburgh's instructions for this route:

"The passage from Hamburg to Hongkong was accomplished in one hundred and twelve days. I was ten days in going from Gillolo passage to the Bashees, and did not attempt to make any easting; while three other vessels, at the same time, took respectively thirteen, fifteen, and sixteen days to make the run from Gillolo to the Pelew islands. Two Siamese captains told me that, although they often made this voyage, they never attempted to run to the eastward, but always bore right away north, during the NE. monsoon. They thus had no difficulty in reaching the Bashees, and always had a great advantage over those who sighted the Pelew islands. Consequently it is advisable to make to the northward as soon as possible. In ten days I encountered eight times a NW. current, and twice a NE. current, with rates of from 22 to 50 miles per day. It is, moreover, a known fact that vessels bound from Hongkong to Shanghai, during the NE. monsoon, pass east of Formosa, and beat up with the Kuro Siwo in their favor. Why, therefore, should you lose time by running for the Pelews when you can bear north under the east coast of the Philippines, where the current is favorable? It should be well understood, however, that if you find a favorable wind for making easting on leaving Gillolo passage, the ship should be headed about NE., but not East, because it is always prudent to clear the zone of calms as soon as possible."

Although this route is rarely used, it may be taken with advantage, under certain contingencies, in time of war for instance.

Route to China and Japan by the south of Australia.—Horsburgh quotes the passage of the *Walpole*, which left the cape of Good Hope on the 21st September, 1794, doubled Tasmania on the 31st October, passed east of New Caledonia, and arrived at Canton on the 5th January, 1795.

He also cites the *Athenienne*, which vessel doubled the island of St. Paul on the 11th October, 1804; entered Bass strait on the 28th of the same month; and after running east of New Caledonia, reached Pedro Branco on the 28th December.

We think that this route can be advantageously followed by vessels bound to Shanghai, during the season of the NE. monsoon of the China sea; and we deem it the best route at this time for ships bound to Yokohama.

Vessels should first steer as stated in § 105, and afterward follow the instructions given in §§ 140 and 177. The reader should refer especially to the description of the two easterly routes, given in § 177. The second of these routes passes between New Caledonia and the Fijis, and is generally preferred by ships coming from Europe or port Adelaide.

Route from Europe to Saigon and Singapore during the NE. and NW. monsoons.—Vessels bound to Singapore should, if possible, cross the tropic of Capricon, in the Indian ocean, east of 82° E., and thence set the course a little to eastward of Engano island, so as not to fetch to leeward, that is, to eastward, of Java head or Palembang. The easterly currents and West winds are strong in these localities. After running through the strait of Sunda (especially with an auxiliary steamer), either Banka or Durian strait can be taken. It often happens that sailing vessels have to pass through Gaspar strait. In this case a sharp lookout must be kept during murky or overcast weather. The line should be crossed near St. Barbe island, and Singapore strait made with the NE. monsoon.

Auxiliary steamers bound to Saigon should, if pressed for time, take the inner route given in §§ 150 and 154, and steam against the monsoon; they can touch at Singapore, in which case they should run through Banka or Durian strait.

Sailing vessels bound to Saigon should take the route by Makassar, already described in this section. They should ascend the Sulu sea and enter the China sea by Mindoro strait. They should cross the China sea, and head for cape Padaran, making a good allowance for the current, and keeping well to windward of all dangers—the Trident, Alexander, Minerva shoals, etc.

For information concerning the termination of the voyage, see § 171. We would observe that the route by Makassar strait is a bad one in December, January, and February. Vessels bound to Saigon should not reach these waters at that season.

§ 152. **Route from China to Europe**—*During the NE. monsoon, from October to April.*—From September to the end of February vessels descend the China sea by the inner route, described in § 171. This route seems preferable at this season, as it is shorter, and a ship can scud, in case she finds violent NE. winds on leaving the great Ladrone. On the contrary, if the outer route be taken, a ship will, under like circumstances, have the wind and sea abeam, and be exposed to much danger, especially if ladened deeply.

The track for March and April runs by Macclesfield bank and east of Sapatu, when it joins the outer route, described in § 171. Quicker passages are made by this route at this season, as it keeps well to the eastward in the China sea.

In all cases, the entrance to the Indian ocean is made by the strait of Sunda.

Vessels should keep a trifle to eastward of 105° E. while crossing the equator, and run through Banka strait, when they come from the inner route; still Gaspar can be used, in which case, after leaving pulu Aor, the course is 15 or 18 miles east of Toti island, and thence for the strait. Coming from the outer route the rule is to take Gaspar strait, as it offers the most direct voyage; still it is a dangerous passage, and there are many instances of shipwreck in that locality. Macclesfield and Stolze channels are the best. On the homeward passage from Singapore either Rhio or Durian and then Banka strait are taken. Vessels leaving Saigon should reach pulo Aor, as stated in § 174, and then take Banka strait.

Once clear of the strait of Sunda, lay the course with the variable NW. winds, to pass east of the Keeling islands, and reach, as soon as possible, the parallel on which it is the intention to run down the longitude. The trades will be found steady between 18° and 19° S., except from February to May, when they are settled at 15° S. It is best to pass about 240 miles east of Rodriguez island, so as to avoid, as much as possible, the zone of cyclones, which are to be feared until April. Thence pass about 100 miles south of Madagascar. After reaching 26° or 26° 30′ S., head WSW. and sight the African coast near port Natal or Algoa bay. For further instructions, see the "Navigation of the Atlantic."

§ 153. **Route from China to Europe.**—*During the SW. monsoon, from April to October.* Ships should return to Europe, at this season, by one of the easterly routes described below.

After leaving Hongkong about the end of April or the beginning of May they should take the first easterly route, follow the west coast of the Philippines, and take Mindoro and Basilan straits. Thence they can either run through Makassar and the strait of Sunda; Molucca passage, Salayer and Lombok straits; Molucca passage, and Ombai strait, or finally passing the Sevangani islands, Gillolo passage, the strait between Bouro and Manipa, and Ombai strait.

Vessels leaving Hongkong, from the 15th May to the end of July, can take the second easterly route and enter the Pacific north of Luzon. Pass east of the Philippines and make Pitt passage by either Gillolo or Dampier straits.

It is not advisable to leave Hongkong in August unless absolutely necessary, or in a well-fitted-out and weatherly ship. However, if it be decided to sail during this month, take the inner route, following the coast of Cochin China, as stated in § 171. The inner route will also be easy to follow after the 1st September (§ 152).

Starting from Saigon, conform to the instructions given in § 174.

Starting from Singapore, it is generally best to run through Durian and Banka straits.

In all cases, after the Indian ocean is once reached, run down the SE. trades, with the wind free on the port tack, and reach 19° or 20° S. near 82° E. Make the westing on this latitude, as the trades are here steady, and pass about 120 miles east of Rodriguez, then about 100 miles south of Madagascar. When about 26° or 26° 30′ S. steer WSW. and sight the African coast near port Natal or Algoa bay. Once around the cape of Good Hope follow the instructions in the "Navigation of the Atlantic."

First easterly route when you leave Hongkong between the 15th April and the 15th May, or later.—Departing from the Grand Ladrone in May, steer southward to the Macclesfield bank. Then steer to the SE. by the wind; although unable to weather point Calavite, variable winds may be expected near the coast of Luzon to carry you round the NW. end of Mindoro. If you adopt the eastern strait, or that formed between Mindoro and Apo shoal, keep within 10 miles of the coast in passing the latter in daytime. Keep about 15 miles from the islands Ambolon and Ilin, in passing, when their southern extremity bears between SE. by E. ½ E. and ENE., to give a berth to coral shoals which lie to the westward of them.

Northumberland strait, or that formed between Apo shoal and the Calamianes, should be chosen if the wind admit.

Whatever passage may have been taken when the wind is from West and you have raised the southern extremity of the Calamianes 16 or 18 miles to the westward, head S. by E. or SSE. and run toward Kiniluban island to pass to the westward of Dry Sand bank. Thence bear south along the west coast of Panay, with the prevailing South to West winds. The weather is frequently cloudy and rainy when these winds blow. The currents are moderate and sometimes set east between Negros and the north of Mindanao.

After leaving Naso point, if possible head SSW., unless the wind is from East, in which case stand for Balagonan point. After reaching the SW. extremity of Mindanao run for Basilan strait.

Route by Makassar.—After leaving Basilan pass through Makassar strait, especially if bound to Batavia or through the strait of Sunda.

European-bound vessels taking this route should shape their course as stated in § 171 and thus sight Tanjong Kaniongan and run down the west coast of Celebes, east of the little Pater Noster group. Thence they should attempt to fetch Allas strait, which can rarely be done without tacking, in order to double the Kalkoen islands and the shoals to eastward. Just here is the real difficulty of the Makassar route, as vessels generally have to work to windward at this season to reach Allas strait. Molucca passage is, therefore, perhaps preferable for a sailing vessel as it will enable her to strike the SE. monsoon well to windward.

Route by Molucca to Gillolo passage.—After leaving Basilan steer for the NE. extremity of Celebes, pass between Banka and Bejaren; thence bear south and run through the channel between Lisamatula and Obi Major, or through Greyhound strait. The currents in the Molucca passage generally set to the north; they are not, however, steady, and the head winds are light and variable.

Vessels arriving off the north extremity of Gillolo or Morti and finding the monsoon strong from SW. will do well to take Gillolo strait instead of the Molucca passage—second easterly route.

The Molucca passage may be pursued, keeping close to Obi Major and passing east of Bouro and between it and Manipa. If you can not run east of Bouro, double the west extremity of the island, as stated under the head of the second easterly route.

Thence, if the prevailing ESE. winds allow, run to windward of Ombai, between that island and Wetta. Follow the NW. coast of Timor and enter the Pacific by the passage between Semao and Savu.

If unable to fetch to windward of Ombai run through Allu or Flores strait. But, these passages being narrow and subject to rapid currents, it is preferable under such circumstances to keep along the north coast of Flores, on the parallel of 8° S., thus avoiding the shoal water near the coast of this large island. The vessel can afterward enter the Pacific by Sapi strait.

Second easterly route.—When you leave from the beginning of May to July, after clearing Lema channel, head South and thus place the vessel in good position for entering the Pacific, if possible, by the channel between the Babuyans and Bashees. SE. winds may be expected between Luzon and Formosa; typhoons are also common in this locality (§ 20). Once within the limits of the Pacific SW. winds and NE. or East currents, with a rate of from 8 to 10 miles per day, may be looked for. After standing SE. and giving cape Engano and Luzon a wide berth, pass west of the Pelew islands if the wind permit, and a little to east of Saint Andrew and Mariere islands and Helen reef. The currents are not very strong north of the latitude of the southern extremity of the Pelew group. But south of 6° N., and particularly between 5° and 2° N., during June, July, and

August, an easterly current, varying from 30 to 60 miles per day, may be expected. Cross this zone as quickly as possible on a South or SW. course and, if drifted very far to the eastward, seek the westerly currents which prevail between 2° N. and the equator. These have a speed of from 15 to 30 or even 40 miles per day near New Guinea and the north coast of Waigiu. Near the entrance of Dampier strait the current sets to the east.

The best route is through Gillolo channel, and to follow it a vessel should, after reaching 2° N., steer for the Asia islands, rounding them to northward, if possible; if not, to southward, between them and the Aiu islands. Afterward double Eye and Siang islands, and pass Gebi on either side, unless the weather is uncertain, when run west of this island. Thence a vessel will have to keep a little east of South to allow for the westerly current which prevails off the southern extremity of Gillolo. Finally enter Pitt passage by the large channel, between pulo Pisang and the Bu islands, or by the passage between Kekik and pulo Gasses, and after running between Bouro and Manipa, make for Ombai strait. But, if unable to reach the passage east of Bouro, or, as sometimes happens, the wind comes out strong from South, follow the north coast of Bouro and run west of that island. Then, if the ship be kept close to the wind, she may still fetch Ombai strait. Look out for the St. Mathew and Welthoen islands, while standing between the west extremity of Bouro and Ombai on the port tack. Make Ombai strait if possible; if impossible, run through one of the straits to westward, Sapi strait is the best. Instructions are also given on the last part of this voyage under the head of the "First easterly route."

CHAPTER VIII.

ROUTES TO THE NORTHWARD IN THE CHINA SEA.

§ 154. **Route from Singapore to Saigon.**—*During the NE. monsoon.*—On leaving Singapore in December, January, or February, it is advisable when the wind is strong from NE. to anchor under the lee of the Water islands in 9 or 10 fathoms. While these gales prevail it is generally rainy for two or three days. At the same time, the currents outside the straits set to SSE., with a speed of 2½ or 3 knots. If once under way the port tack will take the vessel well to leeward of St. Barbe island; navigators are thus enabled to beat up under the west coast of Borneo. After these NE. winds the weather is generally fine; the wind shifts to North and NW., and the current in the offing has a rate of only 1¼ knots. The best time to heave up anchor at the Water islands is at the beginning of the ebb; the course thence is NE., rap-full, so as to pass between Subi or Low island and the Great Natunas. This is easy to accomplish at full and new moon, as the wind after several hours of calm often hauls to the West with rain squalls, then shifts to SW. and South, from which point it blows moderately for about twenty-six hours. Vessels taking advantage of these circumstances, and passing to windward of Subi, will avoid the difficult channels which separate that island from the NW. coast of Borneo. If able to reach Low island and if the wind is steady from East, head about North on the starboard tack, and keep at least 3 miles west of the SW. coast of Low island. Thence continue to run North, and give Haycock island a berth of at least 3 or 4 miles, thus avoiding a coral bank which extends for more than 3 miles from its SW. shore. During the night it is dangerous to run east of this island. After passing Low and Haycock islands, no difficulty will be experienced in beating up for the SW. point of the Great Natuna, as the islands break the force of the SW. current. If the weather be fine a land breeze will be found at night off the south coast of Great Natuna, but do not get closer than 2 or 3 miles if the wind be light, as the water is deep and affords no anchorage. Between Great Natuna and South Natuna, the passage is about 50 miles broad and clear of dangers. Koti passage, between pulo Pujang and Sirhassan, is equally good and about 10 miles broad. There is another good channel south of Sirhassan; it is not as broad, but by keeping close to the south coast of the island all dangers will be avoided. Api passage is the worst of all for a large ship, as the currents are irregular and sometimes set to SW. with great force; besides, she will have to beat through it close under the Borneo coast in 10 or 11 fathoms of water in order to avoid the current and take advantage of the land breeze. Very strong squalls from SE. are, moreover, common in this locality; they are preceded by black rain clouds and last about two hours, the wind hauling to the East as they pass over.

If the North wind holds as far as West island after leaving the straits, take Koti passage, keeping a good distance from pulo Pujang in order to avoid the reef situated south of Flat island. The coast of Sirhassan can be approached from the northward, as there are no dangers in that locality. After clearing the passage do your best to reach 112° E.; this will be easy to accomplish, as the wind is often North and NNW. near these islands; but beyond cape Sirik (about 111° E.) the wind generally hauls to North and NE. Thence stand on the starboard tack, under all plain sail, for cape Tiwane, on the coast of Cochin China. The current will be trifling until the west coast of the banks and 7° N. is passed; but farther north and until the mouth of the Cambodia bears West, distant about 70 miles, SW. currents exist, running at a speed of 3 knots during the strong winds which blow at the beginning of the monsoon.

Toward the end of March and in April, East winds are often found to the eastward of the Anambas islands; these will be kept as far as the Brothers, about 24 miles W. by S. of pulo Condore Beat up inside of this island as far as cape St. James, keeping close to the coast of Cambodia, which is very low and hard to see during the night. After the mouths of the Cambodia are opened, the ebb tide sets to windward, and is consequently very favorable for vessels skirting the land on the starboard tack; on the other hand, they should not approach the mouths of the river during the flood, nor get inside of 11 fathoms during the night. The land can be seen for 10 miles from deck on a clear day. Keep the lead going when on the shore tack.

In May, vessels make the quickest passage from Singapore to Saigon by keeping along the coast of the Malay peninsula and crossing the gulf of Siam. At this season squalls, calms, rain, and a light NE. current are often found off the gulf.

In December, January, February, and sometimes in March, vessels are exposed to gales from NE. and NNE. between pulo Sapatu and the coast of Cochin China. They can be foretold by a gradual rise of the barometer and last two or three days, with a heavy sea and strong current; the barometer begins to fall before the end of the gale; the sky is overcast and heavy. If the land has been seen, and the meridian of cape St. James can be made during the gales, run for pulo Condore and find a sheltered anchorage in Great bay. If the wind be East vessels will find a more snug anchorage at the harbor of pulo Condore, situated between the western extremity of the largest islands and Little Condore.

Coming from the south during the NE. monsoon, make the landfall well to windward and thus avoid being carried too close to Bassok bank and to leeward of cape St. James by the flood tide and permanent SW. by W. coast current. The ebb tide is strong and to NE. by E.; at full and change it commences to run out of the river about midnight. In fine weather the wind commences about 90 miles from land to haul to ENE. and East after 4 p. m., and is quite fresh and squally during the night. Should the ship be to leeward or on the meridian of cape St. James while running for the land, the ebb tide will set her to windward of cape Tiwan by morning. This cape can be seen for 40 miles. It bears ENE. ¼ E. from cape St. James, distant 13 miles, and is generally the first land sighted coming from the south. Being abreast of cape Tiwan, cape St. James looks like two low islands. Cape St. James is the first land sighted when coming from SW.

During the SW. monsoon the wind blows from SE. to West in the strait of Singapore; consequently vessels can easily make to the eastward. Once clear of the strait they should lay a course that will take them between the Brothers and the western extremity of pulo Condore. Due allowance should be made for the current while crossing the gulf of Siam, as it sets to east at about 26 miles per day in this locality. This current is strongest in June, July, and August, at which season there are strong west squalls, heavy thunder, violent lightning, and plenty of rain. The wind remains steady at West for twenty-four hours after these squalls, then hauls to SW. and moderates. When the western extremity of pulo Condore bears South, and the wind is West, and the current setting to the East, head North for the bar at the mouth of the Cambodia. As the rapid currents from this and the Saigon rivers join with the regular easterly current, it is best to keep near the edge of the bar so as not to be set to leeward of the meridian of cape St. James. Keep the lead going, and when less than 10 fathoms are found edge away to the eastward, and thus raise cape St. James to NNE.; thence, head a little above it and run clear of the coral bank lying SW. by W. of the cape.

§ 155. **Route from Singapore to Hongkong.**—*During the SW. monsoon.*—We give below three different routes: 1st, the inner route, followed by vessels starting in March, April, and May; 2d, the outer route, used from the end of May to the beginning of October; 3d, the route by Palawan passage, to be followed after the 15th October.

The inner route runs along the coast of Cochin China, and passes west of the Paracels. The outer route passes east of pulo Sapatu, and between Macclesfield bank and Bombay reef. The third route follows the west coast of Palawan island, and the northern part of Luzon.

The Inner route.—Horsburgh advises this route for March April, and May, and adds that it will be preferable even in June and July if your ship is in bad condition. He remarks that the NW. and West gales, which come from the gulf of Tonquin, are not very frequent, and that by taking this route, disabled vessels will be almost continually in sight of land.

Vessels deciding on the inner route should, after leaving pulo Aor, run along the land as far as the Redang islands, then cross the entrance to the gulf of Siam. Thence double pulo Obi, and follow the coasts of Cambodia and Cochin China as far as cape Touron. From this point make for the SW. point of Hainan, and skirt the eastern coast of that island to its NE. extremity, passing west of the Taya islands. Then stand for the China coast near Huilingshan. According to Horsburgh, all the islands lying between Tien Pak, Huilingshan and Macao can be approached without danger; there are also several harbors of refuge in this locality. Typhoons are common after April. The reader should also refer to the instructions of M. Noel, given in § 158.

The Outer route.—A vessel running out of Singapore, from the end of May to the beginning of October, should, when a trifle to eastward of pulo Aor, head for pulo Sapatu, making due allowance for the easterly current which comes from the gulf of Siam. Horsburgh advises large vessels to steer NNE. after leaving pulo Aor, and until they reach the latitude of Charlotte bank. Thence they should head NE. by N., and sight pulo Sapatu, and, after passing about 15 or 20 miles east of this island, stand about NE. ½ N., allowing for the easterly current. The course from near Macclesfield bank to the Great Ladrone is N. by W.; but when it blows fresh from South or SW., keep this island to the north of N. by E. It will likewise be prudent not to sight the land west of Great Ladrone, and to keep clear of St. John island.

Vessels should not take this outer route unless certain of reaching pulo Sapatu by the first of October. Toward the middle of October the currents about this island set strongly to the southward, and the northerly winds are often light or variable. A ship taking the outer route, and reaching pulo Sapatu after 1st October, should not stand to the eastward until she reaches 13° or rather 14° N., when, the wind being from the northward and eastward, all the shoals will be passed to northward, provided long stretches to northward and short ones to southward be taken while beating over for the Luzon coast. Finish the voyage as in the route by Palawan passage, by running up the coast of Luzon to beyond cape Bolinao.

It is imprudent, especially at the end of October and in November, to approach the China coast to westward of the Great Ladrone.

The route by Palawan passage.—On departing from pulo Aor after the beginning of October pass south of the South Anambas, Low island, and Great Natuna, then head NE., so as to pass between Louisa and Royal Charlotte banks. Afterward edge away to ENE., so as to keep clear of both the Viper shoals, and to sight Balambangan. With a South wind pass from 24 to 27 miles from this island; but when the wind is from West keep about 45 miles off, and head for Balabac island, rounding it at a distance of 27 or 30 miles; finally if the wind be easterly keep closer to both Balambangan and Balabac, as a strong westerly current runs out of the strait when the wind is from that direction. A vessel standing NNE. after leaving Balabac will pass well clear of the banks around Palawan island, and to west of Halfmoon, Investigator, Bombay, and Carnatic shoals. The channel is 27 or 30 miles broad; and it is well to sound during the night, especially between 9° and 10° N., as in many places there is a depth of 50 fathoms close to the edge of the shoals. It is best to pass the SW. extremity of Palawan at about 30 miles, if the wind will permit, and keep along the coast at the same distance. A sharp lookout should be kept for the shoals and rocks, which extend for 15 or 18 miles in a NW. and West direction from the SW. extremity of Palawan.

If the wind should come out from the East, as it is apt to do after the end of October, head for the NE. point of Palawan and the Calamianes when to northward of the shoals; and after sighting the islands steer for Lubang. Thence, coast along the shore of Luzon, and pass near the Sister and Serpent islands. If the wind be from SW. or West, do not keep so close to the shore, especially near cape Bolinao, which is surrounded by reefs; the currents may also set the ship toward the gulf of Lingayen, if care be not used to keep at a good distance from its mouth.

Once past cape Bolinao, vessels can ordinarily cross the China sea by running east of Pratas reef; unless the wind is strong from NE., and the current setting rapidly to SW. In this case it will be better, in an ordinary sailer, to run up the coast of Luzon as far as cape Bojador; from which point the China coast can be made to eastward of the Lema islands. Never run to leeward of this group.

During the NE. monsoon.—Independently of the Palawan route, just described, which can be followed at the beginning of the NE. monsoon, there are two other principal routes from Singapore to Hongkong.

The first route by Makassar strait can be taken when pulo Laut is reached, before the 15th November, or toward the middle of February. The second route by Pitt passage, which also runs through Gillolo or Dampier strait, is advised for December and January.

The route by Makassar.—After leaving Singapore vessels should follow the instructions given in § 115, for the run through Makassar strait. After doubling Mankap shoals and reaching 3° 50′ S., on soundings of at least 19 or 20 fathoms, they should head about E.

by S., keeping along the coast of Borneo in about 18 to 25 fathoms. They should not get in less water until over the bank off Salatan point, where the depth is from 12 to 15 fathoms. This point bears E. ½ S. from Mankap shoals, distant about 276 miles. The track keeps in about 14 fathoms while doubling the highlands of Salatan point; and within 24 or 30 miles of it. Thence head East for the Moresses islands; but do not follow the 18-fathom line, as Horsburgh states that there is a rock near that locality; however, careful navigators can run into as shoal water as 8 or even 7 fathoms. Do not approach the Moresses nearer than 3 miles during the night, and run either north or south of this group. Beyond this, there are two little islands, united by a reef, and called the Brothers. Keep a lookout also for the three islets lying near the south point of the large pulo Laut. Button rock is off the east coast of the southern island. Do not attempt to pass inside of these islets.

The SE. part of great pulo Laut once passed, head up for Makassar strait, and follow the coast of Borneo, as stated in the second part of § 151. But vessels desiring to ascend the west coast of Celebes should, after leaving the SE. extremity of great pulo Laut, steer ENE., if possible, and thus reach Celebes a little to northward of cape Mandar. Soundings should be frequently taken during this part of the voyage, as there are several shoals between Borneo and Celebes. The Triangles and Union bank should be left to northward, and Laurel and Weller banks to southward. In both cases the voyage should be finished as indicated in § 151, under the head of the "Route by Makassar."

Route by Pitt passage.—This route should be followed from December to February. The voyage from Singapore to Pitt passage should be made according to the instructions given in § 115, under the head of the "Proper route during the NE. monsoon." Pitt passage can be reached either from the north of Bouro, or from to eastward of that island, between it and Manipa. For information relative to the latter part of the voyage, see § 151, second route. Gillolo strait is most frequented, especially during December and March. Dampier strait should only be taken in January and February.

§ 156. **Route from Singapore to Manila.**—*During the SW. monsoon.*—Either the inner or outer route can be taken as far as pulo Sapatu, according to circumstances, (§§ 154 and 155). From pulo Sapatu stand to the northward and eastward, and finish the passage as described in § 159. In October take Palawan passage, (§ 155).

During the NE. monsoon.—The route by Makassar strait (see § 155) is used in October, November, and even in December; also during the month of March. After having followed the west coast of Mindoro as far as point Calavite, keep west of Lubang and Cabra islands, and steer for Corregidor islet.

But, from December to February, sailing vessels are obliged to take the easterly route, described in § 155, under the head of the "Route by Pitt passage." Thence, they should run through San Bernardino strait, and pass between Mindoro and Luzon.

In short, sailing vessels should avoid leaving Singapore between the beginning of November and the beginning of February, so as not to have to make the long easterly route. If possible, they should only take the direct route during the SW. monsoon; the Palawan route at the end of the SW. monsoon; or the Makassar route in October, November, December, and March.

§ 157. **Route from Singapore to Shanghai and Yokohama.**—*During the SW. monsoon.*—Make the northing in the China sea, by following, according to circumstances, one of the three routes given in § 155. Whether bound to Shanghai, Nagasaki, or Yokohama, run through Formosa channel. The passage from Van Diemen strait to Yokohama will be easy, as both wind and current will be favorable. Auxiliary steamers can sail through the Inland sea.

It may be shorter, but is certainly less prudent, to run east of Formosa. Vessels bound to Nagasaki, and taking this route, should sight the Hoapinsu islands after leaving the east coast of Formosa; and afterward head so as to pass close to the eastward of Meiaco Sima chain.

Those bound to Yokohama should leave the China sea north of the Bashees, and keep in the Kuro Siwo (§ 37); they should also pass east of the Meiaco Sima, and Luchu chain of islands.

We cannot advise the route via the east coast of Formosa, as vessels are very likely to meet typhoons in that locality, a danger they will probably avoid if they run through Formosa channel.

The reader should also refer to § 160 where he will find a few instructions for the end of this voyage.

The following observations are by an old steamboat captain, of great experience in the China sea:

"July and August are the worst months in the north of the China sea; that is, beyond the head of Formosa channel. In the southern part—from the lower end of Formosa channel to cape Varela—September and October are the worst. Navigation is, therefore, dangerous from July to the beginning of November. It can be stated, in a general way, that there are no typhoons in the Formosa channel, as these storms, ordinarily coming from the east, are broken by the high mountains of Formosa.

"It is advantageous at all seasons to take Formosa channel when bound north. I once attempted the outside route, and had a hard time of it, encountering a gale and a contrary current setting to south at a rate of 80 miles per day. Another steamer that left the same time I did, took the channel, and though a slow vessel, arrived the day after. She had experienced no gale, and found very strong easterly currents.

"The Meiaco Sima islands seem to be especially attractive to all the Pacific storms; besides, the hydrography is uncertain.

"Ill-conditioned vessels leaving Saigon for Yokohama will do well to put into Hongkong, and wait there for a good spell of weather, and until after the new moon. Keep an eye on the barometer after leaving Hongkong.

"The beautiful and safe bay of Pescadores is in Formosa channel; you never lose sight of the China coast, and its numerous harbors, and the typhoons of this locality never attain the violence that they do off the east coast of Formosa. A vessel can make Chusan, if necessary, and thence run for Nagasaki. After waiting here for good weather, she can take the Inland sea, and reach Yokohama with a smooth sea all the way.

"In this manner all the dangerous localities are avoided, while the voyage from Saigon to Yokohama is only lengthened by about 150 miles. The most important point is to be acquainted with the Japanese ports of refuge. Simoda, notwithstanding all that has been thought to the contrary, is a safe, deep anchorage.

"The regular south monsoon between Saigon and Hongkong is variable, and uncertain between Hongkong and Yokohama. In July and August northerly gales are quite common near Formosa."

During the NE. monsoon.—Vessels leaving after the beginning of October will do well to take the easterly route, by Pitt passage, described in § 115. They can make Pitt passage either from the north of Bouro or by passing between this island and Manipa; and afterward make their northing according to the instructions given in § 151.

It will be particularly advantageous to vessels bound to Shanghai and Yokohama to run to the east between 1° 30′ and 3° N. until they can pass to eastward of the Pelew islands. We think this recommendation important. Once beyond 3° N. and the Pelews the wind will generally vary from December to April from West to East, passing by the north point. The prevailing direction, however, will be between NE. and NW. until north of 10° N. As a general rule captains should choose that tack which will give them the most northing. From 10° to 20° N. the prevailing winds are NE., varying sometimes to ENE. and East. A good sailer can cross 20° N. about 132° or 134° E. Between 20° and 30° N. the winds are as often from NW. as they are from NE.; at rare intervals they blow from SE. It is, therefore, generally easy if bound to Nagasaki to cross 30° N. near 132° E. and thence to take the Van Diemen passage. Captains bound to Yokohama should aim to cross 30° N. between 132° and 134° E.; the current will be favorable, and north of 30° N. the variable winds will be favorable. If bound to Shanghai run between the Luchu islands and Oosima island, and thence stand for the Yangtsekiang with the wind abeam.

§ 157. **Route from Saigon to Hongkong.**—*During the SW. monsoon.*—The track follows the inner route described in § 155. Typhoons may be met at this season on the voyage from Saigon to Hongkong. The reader should therefore pay great attention to the observations contained in the section on typhoons of the China sea under "Revolving storms."

During the NE. monsoon.—When the NE. monsoon has once fairly set in the best route is that by Palawan passage. Cross the China sea with a clean full, making due allowance for the SW. current. Pass well to the northward of Charlotte bank and afterward south of Luconia reef. The aim should be to fetch Louisa reef, especially in an auxiliary steamer. Pass either north or south of this reef, according to circumstances, but keep well clear of all the banks lying north of Luconia shoal, viz., Sea Horse, George, and Friendship. They extend for a long distance and generally compel vessels to run south of Luconia shoal.

In all cases, whether trying to reach the passage between Louisa and Royal Charlotte or that south of Luconia, invariably give a wide berth to the Viper shoal and sight Balambangan island. Finish the voyage as described in § 154 under the head of "The Palawan route."

This is a long, tedious voyage, but surer and subject to less bad weather during the strong winds of the monsoon.

Vessels starting from Saigon in October or at the beginning of November, especially auxiliary steamers, can greatly shorten the route by keeping along the coast of Cochin China; taking advantage of the land and sea breezes, they can beat up on short tacks as far as cape Padaran, from which point the port tack will fetch them across the China sea to windward of all dangers after making plenty of allowance for the current. The route then keeps along the coast of Luzon and again crosses the China sea, as stated under "the route by Palawan passage" in § 155.

§ 159. **Route from Saigon to Manila.**—*During the SW. monsoon.*—According to Horsburgh, vessels should sight pulo Sapatu and, after passing the island either to the southward or eastward, head NE., but not to eastward of that point, until they have reached 12° 30′ N. Beyond this parallel the track is for Lubang or Cabra island, and keeps north of all the banks in this eastern part of the China sea. After passing about 9 miles west of Fortune island, which is about a mile in extent and high and rocky, head for Corregidor island, situated in the middle of the entrance to Manila bay.

During the NE. monsoon.—The Palawan route is generally taken, especially by sailing vessels, but the route across the China sea north of all the shoals is perhaps preferable for vessels leaving Saigon in October or at the beginning of November; it is especially adapted to auxiliary steamers. For further instructions the reader should refer to § 158.

§ 160. **Route from Hongkong to Shanghai.**—*During the NE. monsoon.*—Vessels departing from Hongkong bound to Shanghai, in the NE. monsoon, should be in good condition to contend with rough weather, and to carry sail. Upon leaving, the Lyemun or Laruma channel can be taken, the latter being preferable in a large vessel. When clear of the islands, the wind will be found to be about ENE. generally, or as the line of coast trends, and when the monsoon is not heavy, periodical changes of wind occur. At such times vessels should be close in with the land early in the morning, and tack off shore at about 8 o'clock, standing off till about 2 p. m., and on the inshore tack standing boldly in to the coast, making such arrangements during the night as will bring the vessel in a position inshore again in the morning. When the monsoon is moderate, vessels should not stand far into the bays, as they will by so doing experience light winds and often calms, and, on the contrary, when the monsoon is strong they should stand as far as possible in to the bays, and not stand farther off than is actually necessary, especially as the changes of wind above alluded to seldom occur at such times. It would be well to add here, that vessels almost always go faster inshore than they do off, as there is a ground swell heaving after them when in with the land.

During the severe monsoon gales, which last about three days, vessels should seek shelter in one of the numerous good anchorages to the westward of Breaker point, when, upon the breaking up of the gale, they can make a fresh start, and perhaps get around Formosa before encountering another, especially after the month of November.

Having reached Breaker point, vessels should then stretch over for the south end of Formosa, and upon getting to the eastward, the wind will be found to veer northerly, or more, as the coast of Formosa trends; and a good sailing vessel will be almost sure to fetch the south cape or Lambay (Lamnay) island to windward. Upon getting in with the land, light variable winds and calms are often met with, but the strong current to the SW. will very soon drift the vessel down, when she will find the breeze coming on fresh again. In passing the south cape in the daytime, vessels should keep close in to the land, and the nearer the shore the stronger the favorable current, there being no hidden dangers. In passing around in the night, however, and when there is no moon, it will be advisable to pass to the southward of the Vele Rete rocks, and to tack to the NW. when nearly in the longitude of Gadd reef, or sooner if it is daylight, as the south cape of Formosa is very low, and rather unsafe to approach in a dark night. When a gale comes on, and a vessel, being to the westward of the cape and near it, is obliged to heave to, a strict lookout should be kept during the night, as several vessels, under these circumstances, have found themselves to the eastward of the cape in the morning, having been drifted to windward during the night, and passed, probably, within a dangerous proximity of the Vele Rete rocks. The current sets sometimes with incredible velocity round the cape, and then up northward, along the coast, and the stronger the northerly gale, the stronger the weather current, gradually diminishing in strength toward the north end of Formosa. After rounding the cape, vessels should work short tacks along the east coast of Formosa, keeping close inshore to get the benefit of the current.

Having reached the NE. cape of Formosa, and the wind does not veer to eastward, which is sometimes the case, vessels should keep between the meridians of the Barren islands and the islands off the north end of Formosa, and not stretch in for the coast of China until able to make a lead in for Video or Leuconna.

General remarks.—This is a dangerous voyage during the strength of the NE. monsoon, and ships generally experience a double-reef topsail breeze and nasty sea until they pass the Bashees, when the weather becomes considerably better.

After leaving the Lemas the best plan is to keep well in with the land and make to the eastward as much as possible. As the current is contrary it is well to beat up in the smooth waters of the bays during the day, and in case of heavy winds to anchor until the weather moderates. Do not be afraid to work to the eastward whenever the wind permits, and run in for the land when the wind comes out ahead. This is the worst part of the voyage, and requires much attention.

Once clear of the south cape of Formosa, vessels can run either east or west of the Meiaco Sima group, but vessels keeping close to the coast will find a northerly current as far as cape Formosa. When the wind varies from North to East off shore, it sometimes blows strong from NW. inshore, and it is then advisable to take that tack which will keep the ship out of the influence of the land breeze, and to stand on until a good anchorage can be fetched to leeward of one of the Kweshan islands.

With northerly winds the barometer is always very high, and is therefore of much use in this locality. After reaching the south point, the wind often jumps around suddenly to North. Look out for this shift of wind, and reduce sail in time. The squalls never last long.

Captain D. W. Stephens gives the following route as the best in his opinion for reaching the south point of Formosa in March and April (Ann. Hydr., 1870):

"One of the usual routes at this season runs through Bashee channel, or through one of the passes between Formosa and Luzon, but vessels sometimes by so doing are delayed a week, beating along the coast for Breaker point against the NE. monsoon and a westerly current. A better route from Lema channel is to run SE., with everything full. The westerly current will thus be avoided, and easterly or southeasterly winds found near the coast of Luzon. A ship by following this track can then head NNE., and, the strong current helping her, will probably fetch to eastward of Formosa in less time than if the attempt had been made to beat up for Breaker point along the China coast."

During the SW. monsoon.—If reference be had to § 157, it will be seen that Formosa channel is rarely visited by very violent typhoons.

§ 161. **Route from Hongkong to Japan.**—*During the SW. monsoon.*—Vessels should take Formosa channel, and first run as if bound to Shanghai, (§§ 157 and 160).

Sailing vessels should go through Van Diemen strait, or the two passages more to the southward; and thence can easily reach Yokohama. Steamers and auxiliary steamers can follow the same route, but it is probable that they would do better if they took the inner route, as described in the extract given in § 157.

During the NE. monsoon.—Whether bound to Nagasaki or Yokohama, vessels should, on starting, follow the instructions given in § 160, for reaching the south point of Formosa, and for ascending the east coast of this island. Thence they should keep to westward of the Meiaco Sima and Luchu chain, and thus take advantage of the Kuro Siwo. The NE. winds are not here so persistent or strong as they are to eastward of the islands, and there is a chance of finding variable winds. If the wind allow stand well to the northward and eastward and pass north of Oo Sima island; but if headed off take the port tack and run west of the Linschoten group. As soon as the ship strikes favorable winds, which she will generally do about 30° N., head her to the eastward, and take one of the passages north of the Linschoten group, or strictly Van Diemen strait. The run from here to Yokohama is easily accomplished.

§ 162. **Route from Manila to Hongkong.**—*During the SW. monsoon.*—This is an easy passage at this season. After crossing the China sea, head directly for the Great Ladrone. If the wind is free and from SW., Horsburgh advises ships to make this island, bearing N. by E. or North when approaching it from the China coast. If the wind incline toward NE., it is best to sight Great Lema and enter the neighboring channel. Remember that typhoons are frequent from July to November, (§ 20.)

During the NE. monsoon.—Run up the west coast of Luzon to cape Bolinao. A good vessel can cross the China sea from this point if the wind draws aft enough to let her head North. But when the wind is from NE. or North, and the current sets to SW., it is preferable, especially with an ordinary sailer, to beat up the coast of Luzon as far as cape Bojeador, and then cross the China sea. For information concerning the latter part of the voyage, see § 155, under the head of "the route by Palawan passage."

§ 163. **Route from Manila to Shanghai and Yokohama.**—*During the SW. monsoon.*—This route does not present any difficulties. Vessels should steer strait for Formosa channel, and thus avoid the typhoons frequent among the Bashee and Meiaco Sima islands. For further information, see §§ 160 and 161.

During the NE. monsoon.—At this season keep along the coast of Luzon until near cape Bojeador. On leaving this cape, or even point Banqui, with a settled NE. wind make a long stretch on the starboard tack to NNW. However, as it is not well to get too far from the Bashees and the Babuyanes, the ship should now and then go about and stand toward them on the port tack, heading about ESE. The south point of Formosa should then be reached as soon as possible. Auxiliary steamers can, of course, keep their engines turning over slowly and, lying a little nearer the wind when on the starboard tack, reach Formosa in less time than sailing vessels. Pass east of this island and stand to the northward with the current in your favor.

§ 164. **Route from Shanghai to Japan.**—As this route lies north of 30° N. the variable winds beyond that parallel will materially assist vessels on the voyage to Japan. When bound to Nagasaki they can steer a direct course. Sailing vessels bound to Yokohama should, as a general thing, take Van Diemen strait or one of the more southern passages if forced by the wind. Steamers and auxiliary steamers bound to Yokohama should generally pass through the Inland sea, especially during the summer (§ 157).

Ships bound to Hakodadi through the Japan sea, after leaving the lightship off the mouth of the Yangtsekiang, run close to the Amherst rocks when the wind is favorable, passing them on either side, according to circumstances. Then head for Fsu Sima, in the strait of Korea, and leave it to port. Thence sail through the mid-channel between Hornet and Oki, where the current is strongest. When the wind is strong from the eastward keep north of this route and run between Quelpart island and the Korean coast. This is a safe passage, the current being rapid and favorable. After passing Hornet rocks it is best to stand for the coast of Nipon and cape Yokoiso, behind which there is a very high mountain, visible 60 miles in clear weather. In order to counterbalance the effect of the current head about half a point to eastward of the direct course until beyond 39° 30′ N. As the current here commences to run to NNW., and beyond that parallel often attains a speed of from 40 to 50 miles per day, when the wind is strong from South, a whole point should be allowed for drift.

Due allowance should especially be made for the current when the weather is overcast or foggy and no observations have been obtained.

Notwithstanding the fact that allowance may be made for drift the current will be apt to set the vessel well over toward Oo Sima and Ko Sima islands when standing for the western coast of Japan. These islands form an excellent landmark to the entrance of the Tsugar strait. They can be seen for 25 or 30 miles on a clear day, and a ship can pass on either side of them or between them, the shore being bold and clean. It is, however, always preferable to leave them to port; that is, to northward, as they bear due East from Matsumai point, which forms the NW. limit of the strait.

It is not advisable for navigators unacquainted with this locality to run through Tsugar strait at night, as the breeze often dies away about sunset. Mistakes may be made about the different points and the ship be drifted into the Pacific; in which case it may take her a week to make up for lost time.

On approaching the land during the day it is best to keep close to cape Tsiuka, situated about 18 miles north of Hakodadi on the north coast of the strait. Thence keep along the north coast for Mussel point, thus taking advantage of the favorable eddies in the current if the wind die away.

§ 165. **Route from the southward to the gulf of Pechili.**—When north of the Chusan archipelago steer to pass from 10 to 20 miles clear of the eastern end of the Shantong promontory. The winds of the Yellow sea are variable and every advantage should be taken to make northing. When up with the promontory steer NW. to the straits of Pechili, inside the gulf. Care must be taken in approaching the shore, as the mud banks extend well off shore.

§ 166. **Routes from Japan to the gulf of Pechili.**—From all parts of eastern or SE. Japan follow directions in §§ 168 and 165.

From Nagasaki keep well to the southward of Quelpart island and then follow § 165.

CHAPTER IX.

ROUTES TO THE SOUTHWARD IN THE CHINA SEA.

§ 167. **Route from the gulf of Pechili to China and Japan.**—Pass out through the strait of Pechili or, if more current, by the southern passage, though this is not recommended; if bound for the west coast of Japan pass between Quelpart and the Korean coast; if from SE. or eastern parts of Japan stand well to the southward and pass through Van Diemen strait. If bound to China work down the coast well off shore and follow instructions in § 169.

§ 168. **Route from Japan to Shanghai.**—Sailing vessels leaving Yokohama during the winter (from October to March) should stand out to sea, and make to the southward. They will generally find the NE. monsoon, south of 30° N., at this season. Thence they should head for Oo Sima, and passing to northward of this island make due allowance for the current, which sets to North and NE. In summer it is possible to keep near the land, and in the strength of the Kuro Siwo current. Sailing vessels should afterward run through Van Diemen strait, unless they wish to take the route through the Inland sea.

Auxiliary steamers will find it greatly to their advantage to take the route through the Inland sea, especially during the summer. From May to October it is never safe to approach Oo Sima island, as typhoons are frequent in that locality.

The following observations, on the voyage from Hakodadi to Shanghai, by Captain Scott, may be of interest:

"The westerly winds render it sometimes difficult to cross Tsugar strait; however, I incline to the opinion that this route is better than the one to eastward of the Japan islands, as it is about 300 miles shorter, and the weather in Van Diemen strait is worse, and the contrary currents much stronger than they are in Tsugar strait. It is a known fact that vessels taking the easterly route make long passages.

When I run out of Hakodadi, with the wind between West and SW., I always stand for Mussel point, which is situated on the opposite side of the bay. After rounding this point, as close as possible without danger, I beat up along the coast of the bay, making short tacks and thus keeping within the counter current. In this manner I generally reach cape Tsiuka before dark, where there is an excellent anchorage in from 6 to 12 fathoms off the little village.

Cape Tsiuka bears South from this anchorage, distant a little less than a mile. I think this the safest spot in the bay, as a ship can always get under way without difficulty if the wind should suddenly shift to East, and the SE. counter current is not very strong. It is certainly a far better anchorage than the one marked on the Admiralty chart, as it is difficult to beat up from the latter in case the wind should come out from East; the holding ground, also, is not good, the bottom being of hard sand, while the bottom off cape Tsiuka is a kind of mud, formed by the debris from the adjacent mountains.

"If the West wind holds, get under way at daylight and run along the north coast of the strait as far as Matsumai point. Thence stand across the strait on the starboard tack for cape Greig; the wind will generally draw aft one or two points abreast the entrance of the strait. Between cape Tsiuka and Matsumai point the coast is not clean, but there is no necessity of running close to it, as the current moderates considerably beyond cape Tsiuka. After clearing the strait, and reaching 37° N., it is well, when the wind is South to stand in for the coast of Japan, and run inside of the Oki islands. By so doing a ship will be out of the strength of the current, and may even find a favorable drift as far as Hirado channel. I have often passed inside of the Minosima, Katsusima, and Oronosima islands, and found the coast clear as far as Oronosima. ESE. of this island lies a small rock, 8 or 9 feet above water, with a considerable outlying reef. During the night this rock is easily mistaken for a small vessel or a junk.

"After this it is best to make for Korea strait; but it is to be hoped that when the survey of these localities is complete, vessels will be able to keep inside of the Goto islands, and thus avoid the strong currents of Korea strait, when the wind is strong from the West.

"Once clear of Korea strait, it is not usually difficult to reach the China coast, as the monsoons generally blow from North or South. This part of the passage is ordinarily made in from three to five days, and sometimes in thirty-six hours when bound north. During either monsoon it is best to make the land near Shaweishan island or Amherst rock, where there is an anchorage in 6 or 7 fathoms, if the wind die away. Vessels are also likely to have one or two tides in their favor in this locality. Near the Saddles, the southerly currents and tides are often strong during the NE. monsoon.

"The passage from Shanghai to Hakodadi has always seemed to me shorter and easier than the return voyage, the current being more favorable. We made our quickest passage to the northward in May, and our longest in October, the length of the respective voyages being nine and sixteen days. Our quickest passage to the southward was made in eleven days, during November, while our longest was twenty-nine days, in June. Passages have been made in six or seven days."

§ 169. **Route from Shanghai to Hongkong.**—Vessels should always pass through Formosa strait.

During the NE. monsoon.—In the NE. monsoon there is a constant current down the coast, running with more or less velocity, according to the strength of the wind; and the wind generally blows along the line of coast, that is ENE. from Hongkong to Breaker point, NE. in the Formosa channel, and NNE. from Formosa north. The first part of the monsoon is very strong, and frequently in the month of October it is almost an incessant gale; in the latter stage, from January to May, SE. winds are not uncommon, and the more frequent as the season advances; there is considerable thick weather in the latter part of the monsoon, and a SE. wind to the northward of Formosa almost invariably brings a dense fog with it.

During the SW. monsoon.—The passage from Shanghai to Hongkong in the SW. monsoon is very tedious from the frequent calms and squalls and constant strong current up; and coasting vessels generally use their kedge when there is not sufficient wind to make any progress. In working down it is well to keep in with the coast, stretching into bays and by headlands to get out of the current, if there is sufficient wind to preclude the probability of getting becalmed.

§ 170. **Route from Hongkong to Manila.**—*During the SW. monsoon.*—Vessels should aim to leave Macao for Manila when the wind hauls to SE. or East, so as to make to SSW. or South toward Macclesfield bank. This bank once reached, it is easy to fetch to windward of Manila, unless the wind comes out from SSE. and South. If the wind is from the southward, sight Goat island or the land south of the bay.

It will be perceived that this route is the same as that given in § 153, in the description of the first easterly route. We think it is not advisable to leave Hongkong from May to September, as it is exceedingly difficult to reach Macclesfield bank during these months. Of course the difficulty will be less with steam to fall back upon.

The reader should remember that typhoons are frequent in these parts (§ 20).

During the NE. monsoon.—This is the favorable season for making this passage. Vessels should run out by the Lema channel, and head up well to the east for cape Bolinao, if possible, as the currents set to leeward. When nearly as high as cape Bolinao they should keep some distance from the banks along the coast of Luzon. After doubling cape Bolinao and the Sisters, keep along the land at a distance of from 12 to 18 miles, until past the islands and rocks of Capones point, when run in closer and steer for Manila bay.

§ 171. **Route from Hongkong to Saigon and Singapore.**—*During the NE. monsoon.*—From September to the end of February it is best to take the inner route, along the coast of Cochin China (§ 152). This route is especially advantageous for deeply laden vessels, as they will have the wind aft all the way from the Great Ladrone. In March and April the outer route is preferable.

The following instructions are condensed from Horsburgh's work:

The course from the Great Ladrone is SSW. ½ W., the route passing between the Taya islands and St. Esprit shoal, and at a convenient distance from the Paracels. The currents are very strong along the China coast and run at the rate of from 15 to 24 miles per day in the offing. When the wind is ENE. between the Paracels and Hainan it causes a current in the opposite direction. Between the Great Ladrone and the coast of Cochin China the westerly currents have a speed of 15 miles per day in moderate weather and of 24 miles with strong winds; vessels should not, therefore, steer too southerly, but keep between SSW. and SSW. ½ W. prior to reaching 17° N. and the channel to westward of the banks. This course should fetch them three degrees to the westward of the longitude of the Great Ladrone when on the 17th parallel, the course thence to cape Varela being S. ½ W. or S. by W. If the weather be overcast or the wind be inclined to haul to the eastward, as the current sets in toward Quinhon, it is well not to approach land before up to cape Varela. Beyond 15° N. the littoral currents are strong and southerly, reaching a rate of from 40 to 60 miles in twenty-four hours, from 14° 30′ to 11° 30′ N. If land was not sighted above cape Varela it is advisable to run in for it and keep 12 or 15 miles from the coast.

The route to Saigon is near land and to westward of Holland bank. Abreast the southern part of false cape Varela the course is SSW. or SSW. ½ W. across the gap of Padaran. The SSE. current should be attended to in this locality, and at a moderate distance from shore the lead will show 40 or 50 fathoms. Cape Padaran is easily recognized on a SSW. course, and can not be mistaken, as the low land at the bottom of the gap gives the cape an isolated appearance. It should be passed at 5 or 6 miles on a SW. by W. course, which will carry the ship about 6 miles outside of pulo Ceicer de Terre; cape Padaran can, however, be approached much closer, and pulo Ceicer de Terre still be doubled. The island once passed at a distance of from 4 to 6 miles, in daytime steer SW. by W. until it bears N. by E. ½ E.; it will probably be lost on this bearing. Then, after running 18 or 21 miles SW. by S., the ship will be west of Holland bank and the remainder of the passage is easy. As at night Saigon light is visible 28 miles, and during the day cape St. James is easily recognized, the only precaution is to round Britto shoal to the eastward.

Bound to Singapore.—After passing west of Holland bank the course is SW. by S. for pulo Aor, but it is preferable to keep outside of pulo Sapatu, in which case the course from false cape Varela is South or S. ½ E. and to eastward of pulo Ceicer de Mer and pulo Sapatu. In overcast weather it is best to be on the safe side and steer SSE., as the currents set rapidly to SW. and WSW. toward pulo Sapatu, and a ship may be forced to pass the night between the island and Catwick.

In very clear weather vessels may pass close to eastward of pulo Ceicer de Mer and run west of Great Catwick on a SW. course, whence the course is straight for pulo Aor. When east of pulo Tioman in thick weather keep in 32 or 33 fathoms.

After passing from 6 to 12 miles from pulo Aor the course for Banka strait is SSE. ½ E. or SSE., depending upon the strength of the wind and current, being careful to keep in at least 23 or 24 fathoms when between 0° 40′ and 0° 56′ N. After passing outside of Geldria bank a SSW. course will carry the ship 12 or 15 miles from the east point of Linga; this offing is necessary, as Ilchester bank bears South from the point, distant 8 miles, and the current sets toward the shoal.

When abreast of the east point of Linga, distant 15 miles, set the course at SSW. ½ W. and run between pulo Taya and the Seven islands, and then head S. by W. for point Batakarang, passing it at a distance of 20 miles, as Frederick Hendrick rocks are on the east side of the channel.

Outer route in March and April.—This route passes by Macclesfield bank and east of pulo Sapatu. Vessels should adopt the outer passage in March and April. They should run for Macclesfield bank on a S. by E. ½ E. course with moderate winds, or on a SSE. course with strong winds and a heavy sea and current. Pass between the bank and Bombay reef. From the bank to pulo Sapatu the course is SW., but if soundings are obtained over the bank it is best to head SW. ½ S. until the parallel of pulo Sapatu is reached, and then if the island be not sighted to steer SW. by W. or WSW. until in 35 or 36 fathoms. This caution is necessary, especially in thick weather or at night; in fact, at such times it is advisable to keep well to the eastward of pulo Sapatu until near 10° N., when head SW. by W. or WSW. and run for soundings. Some captains keep SW. by S. from Macclesfield bank, and in March, April, and May run a great distance to the eastward of pulo Sapatu. If this route be taken look out for the SE. currents, which are liable to sag vessels over toward the shoals to eastward of pulo Sapatu.

The parallel of 10° N. once reached, the course is SW. by W. and WSW. until bottom is found at 35 fathoms, SSW. ½ W. for pulo Aor or pulo Tioman. When near 7° 6′ N. do not get in less than 30 or 32 fathoms, and look out for Charlotte bank. European-bound vessels should, in March and April, stand well to the eastward, and passing between the Natunas and Anambas, run for Gaspar strait.

During the SW. monsoon.—A good sailer can take advantage of the series of East or SE. winds which often blow for several successive days at this season, she can make the voyage from the Great Ladrone to the Indies by the inner route. In this way the voyage from Hongkong to Singapore is sometimes made in twenty or thirty days; but in order to succeed they must, from the beginning, take advantage of every favorable circumstance, and while standing to the southward and westward keep as close as possible to Hainan and the coast of Cochin China. However, the very best sailing vessels should not attempt this route in June, July, and August unless absolutely necessary, but take the easterly route.

Bound to Saigon.—In short, it is important, if not indispensable, that sailing vessels bound to Saigon should start before May when they can make quite a rapid passage by the inner route. But even the outer route will be difficult for a sailing vessel in June, July, and August; the head winds and currents, the reefs to be avoided, and the danger of meeting a typhoon, all combining to make the voyage long and even dangerous. The inner route is not so bad for a staunch, well-fitted-out, auxiliary steamer, and can be followed without great difficulty. Still, she should not attempt to economize coal, but get up steam as soon as possible.

Bound to Singapore.—Vessels bound to Singapore should follow the instructions given in § 153. Thus, if they leave Hongkong from the 15th April to the 15th May, they should take the first easterly route; if they sail from the 15th May to the end of June, they should take the second easterly route. They should avoid starting in August, and if they leave in September should take the inner route described at the beginning of the present section.

After leaving Hongkong from the 15th April to the 15th May, vessels should run through Mindoro and Basilan straits, as described in § 153. The winds and currents from Basilan to cape Dondo are very variable. If the wind be found steady from East, the aim should be to sight cape Dondo to SSE. or South. Ordinarily, the winds haul to the westward on approaching Celebes; these, of course, making an easterly drift, it is prudent to keep well to the westward and sight Tanjong Kaniongan. A ship fetching to the eastward of cape Dondo will find it slow work beating up for the strait.

Keep along the coast of Celebes while in Makassar strait, and thus find the vessel well to the windward on striking the SE. monsoon. The only place where it is important to keep an especial lookout is near the latitude of Laurel bank and the dangers situated north of the Noesa Seras islands. For information concerning the remainder of the voyage the reader should refer to § 155, where will be found instructions relative to this route under the head of "The route from Singapore to Makassar strait during the NE. monsoon."

If the wind is foul for Makassar strait, head for Molucca passage, as stated in § 153, and pass successively between Banka and Bejaren, (NE. point of Celebes), then between Lisamatula and Obi Major, or through Greyhound strait, situated west of Taliabu. As the wind prevails from SE. and East beyond Obi Major, a ship will be in a particularly good position for making from that point to the NW. part of Bouro, and for finishing the voyage, as indicated at the end of the second easterly route.

Starting from Hongkong, from the beginning of May to the end of June, a vessel should shape her course as stated in § 153, for entering the Pacific by one of the passages north of Luzon. After running down the east coast of the Philippines as far as Gillolo or Dampier strait, head for the NW. part of Bouro. Observations on this part of the route will also be found in § 153. After reaching the NW. extremity of Bouro, head about SW., and if the wind be fresh from the SE., allow half a point for northerly drift Navigators should, if possible, manage to make the most northern of the Toekang Besi islands during the day, and double it at a distance of 2 or 3 miles. Thence they can easily weather the south point of Buton, and head W. ½ N. for Middle island in Salayer strait, being careful to avoid Cambyna island if in that locality at night. It is not advisable to run between Middle and South islands after dark, unless at home in the neighborhood, as these islands are easily mistaken for each other. After leaving Salayer strait make to the westward, running on either side of Brill rock (Taka Rewataya) as most convenient. Pass close by Great Solombo; keep clear of the reefs off pulo Mankap, and make for Carimata passage. Thence shape the course for the northern extremity of Banka and run through Singapore strait. Vessels should reach this strait by giving a good berth to Geldria bank, and then running for pulo Panjang, afterward sailing close around the north coast of Bintang and passing between that island and Pedra Branca.

§ 172. **Route from Manila to Saigon.**—*During the NE. monsoon.*—Once in the offing, stand across the China sea, making due allowance for the SW. current, so as pass well to windward of all the reefs, particularly Trident, Alexander, and Minerva. Make the coast of Cochin China near cape Padaran, and finish the voyage by following the inner route given at the beginning of § 171.

During the SW. monsoon.—The passage will be rough, long, and very difficult at this season. Sailing vessels should avoid it during June, July, and August. There are, however, three routes from which to choose.

First route.—In March, April, and the beginning of May, it is possible to cross the China sea, after leaving Manila bay, by keeping north of Macclesfield bank and the Paracels. After running close to the coast of Haïnan the aim should be to follow the inner route described in § 171. Good vessels can do this even in June and July, but should not attempt it, unless absolutely necessary after the SW. monsoon has reached its maximum strength, as typhoons are then common.

Second route.—This route runs through Mindoro strait, east of Palawan, across Balabac strait, and thence along the west coast of Borneo, until far enough south to cross the China sea. As the currents are strong to North and NE., it is necessary to keep well to windward of all reefs, especially Luconia and Vanguard.

Vessels can also follow an analogous route through Palawan passage, but only in April, or the beginning of May. Both these routes will, of course, be greatly facilitated by the assistance of steam.

Third route.—This route passes through Makassar strait, and, though longer than the others, will be found easier for average sailing vessels (§ 171, first easterly route). By taking this passage they will avoid the chance of meeting a typhoon, and will always find favorable winds beyond great pulo Laut, from SE. to southward of the line, and from SW. to northward.

§ 173. **Route from Manila to Singapore, the strait of Sunda, and Europe.**—*During the NE. monsoon.*—Vessels should steer W. by S. from Manila bay to the parallel of 12° N., and keep on this course if they are not certain of being at least nine degrees west of Goat island. They should afterwards head SW. for pulo Sapatu, thus allowing for drift, as the westerly currents are at times very violent, and the dead reckoning is not to be relied upon. If the island is not sighted after the parallel of pulo Sapatu is reached, the course should be SW. by W. until soundings are found; thence SSW. ½ W. for pulo Aor, as stated in § 171, outer route. For information concerning the end of the route, see § 152.

During the SW. monsoon.—We think that the first easterly route, described in § 171, can be followed during the whole period of this monsoon. Vessels should run through Mindoro and Basilan straits, and then make for Makassar strait, when the winds will allow, that is to say, in April and May; otherwise Molucca passage may be taken. In this case they should double Bouro to NW.; Buton to SE. and South, and then take Salayer strait and Carimata passage.

It does not seem that there is any special advantage in taking the Pacific or second easterly route. It can, however, be followed; in which case the track is through San Bernardino strait, and reaches Pitt passage, by Gillolo or Dampier strait, as described in the description of the second easterly route (§ 153). Finish the voyage as indicated at the close of (§ 171). European-bound vessels should follow the same route and end the voyage as stated in § 153.

During the months of March, April, and May vessels can still take the Palawan route; and, in relation to this subject, we give the instructions of Captain Stephens, commanding the *Harkaway* (Ann. Hydr., 1870):

"Vessels leaving the coast of China or Manila, and bound to the strait of Sunda, during March, April, and the beginning of May, should expect to make a long passage if they follow the old route, which passes near pulo Sapatu. If, on the other hand, they keep along the coast of Luzon, cross Palawan passage, run along the Borneo coast, pass near Direction island, double Seruta island, take Carimata strait, running close around the North Watcher, and thence steer for Saint Nicholas point on the island of Java, they will probably meet East winds, fine weather, and a smooth sea all the way. This is a direct route and clear of calms. Prior to the end of May, the currents are more favorable than by the other route.

"On nearing the strait of Sunda, vessels should stand over for the coast of Java, and in May keep close to the land, as the wind is then light; from SE. during the night, and from NE. during the day. By following these directions they will avoid all danger of being set toward Button islet by the westerly current. The current always sets to SW. in the middle of the strait; its force is diminished during the short flood tide, but increased during the long ebb."

§ 174. **Route from Saigon to Singapore.**—The following instructions are due to Captain Loftus of the ship *Kensington* (Ann. Hydr., vol. 23):

During the NE. monsoon.—"After leaving cape St. James pass east of the coral shores and pulo Condore; thence head for pulo Aor, allowing for the currents which set toward the gulf of Siam. Approaching pulo Tioman during the night or in bad weather, it is necessary to look out for the SW. current, which tends to set vessels into the bay on the coast of Malay, to westward of pulo Tioman. When the weather is overcast and the wind strong it is best to bear up and double pulo Aor to leeward, so as to wait for a favorable opportunity for running through the strait. The current sets to SSE., between pulo Aor and the eastern point of Bintang; it is also well to steer SSW. ½ W. from pulo Aor to the Malay coast; and then to keep along the land at a convenient distance. Vessels should pass through the north channel, doubling the Romania islands at a distance of 3 miles. They will then be on the windward side of the strait, and can anchor under the lee of Water island if the weather be bad. Vessels keeping too far to the southward, after leaving pulo Aor, are often drifted to leeward of Bintang by the current and ebb tide, which runs out of the strait. If this happens they are obliged to take Rhio strait. In March the East winds are fresh, the current slow, and the weather fine. In April the East winds are interrupted by calms and squalls. The monsoon dies away between the end of April and the 15th May. In May the winds and weather are variable, with thunderstorms and squalls. Toward the end of this month the northerly current commences to flow."

During the SW. monsoon.—"At this season a fair wind will be carried from the river to cape St. James. The wind along the coast is frequently from North and NE. at night, and at times from these points for a few moments during the day. A ship taking advantage of these local winds, while running to the SW., can sometimes carry them for 40 or 50 miles to the southward and westward of pulo Condore. Quick passages have been made by keeping under the coast of Cambodia, as far as the Brothers and pulo Obi, and thence by crossing the gulf of Siam with a strong NW. wind, beating up the coast of Malasia with the tide, and passing inside of pulo Tioman, Siribuat, and pulo Sibu. Thence make for Singapore strait, taking advantage not only of the tides, but of the land and sea breezes, which are frequent at this season during fine weather. This route is used by vessels returning from Siam and sometimes from Saigon; but the passage to eastward of the Great Natuna is considered the best, especially for large ships.

"Vessels heading SE. on the long starboard tack meet the strongest current near Charlotte bank. It afterward diminishes and becomes slightly favorable SW. of Great Natuna. Here a SE. or East wind is generally struck, and a bad sailer can often pass between Soubi and Low islands, and then lay a course for Singapore strait. Strong West winds and rain are common at the beginning of the monsoon, though the wind is sometimes from the South. Bad sailers should therefore be very careful how they approach the coast of Borneo near cape Sirik; and make the land between Tanjong Datu and Burong islands, by taking the Api passage. This they can easily do, as they will find land and sea breezes, and only a slight current near the shore. In Api passage, between Tanjong Datu and Tanjong Api, a ship should not go closer than 2 or 3 miles to the islands, nor in less than 14 fathoms of water; it is also advisable to have an anchor ready for letting go.

"After leaving Burong, the attempt should be made to fetch pulo Panjang on the port tack, passing either north or south of the Tambelans. Pulo Panjang is off the east coast of Bintang. Take the south channel, passing 2½ or 3 miles from the NE. point of Bintang in order to clear the Postillion, and make allowance for the tide by keeping on the southern or windward side of the strait. When off Rhio strait remember that the flood sets toward it."

CHAPTER X.

ROUTES FROM THE AUSTRALIAN PORTS TO ASIA AND CHINA.

§ 175. **Northerly route from Australia to India, Batavia, and Singapore.**—*From Sydney to Torres strait.*—During the SE. monsoon, from May to August, steamers and auxiliary steamers should, after leaving Sydney, follow the inner route advised by King, and keep along the coast of Australia inside of the reefs.

Sailing vessels, strating from May to the end of June, should follow the outer route, which passes east of Gato bank and Wreck (Naufrage), Kenn, and Dina reefs. Thence they can cross Torres strait by the passage near Raine island or the one near Bligh island. The Bligh passage is preferable.

The outer route is more likely to interest commanders of merchant vessels, whose chief object is generally to make a quick passage with the least amount of labor. This route, no doubt, possesses this advantage; but it must be borne in mind that the passage through the Great Barrier reefs, from the Coral sea into Torres strait, is frequently attended with danger, and sometimes the loss of the vessel, notwithstanding the recent surveys and the erection of the beacon on Raine island. These disasters, however, would doubtless be less frequent were the Great Northeast (Bligh) channel more used, as it may be generally navigated by night, so that the time and labor saved by not being compelled to anchor so frequently as in the route by Raine island would more than compensate for the 90 miles which the former route exceeds the latter in distance.

Notwithstanding all that has been said in favor of the inner route, supported by the weighty authority of Captain King, the outer route is undoubtedly preferred by nearly all the merchant vessels bound from Sydney to Torres strait, more especially since the late survey of the Coral sea.

Opinions are divided as to the respective merits of the various routes through Torres strait. During the season of SE. winds, that is from May to September, either the channel by the Raine island beacon or that near Bligh island, situated north of Darnley, furnishes a quicker route than the passage along the coast inside the reefs. Such being the case, merchant vessels make use of this outer route, as much time is gained thereby.

Steamers bound to India during the west monsoon, that is, from

November to March, will find it greatly to their advantage to take the Torres strait route. And I think Captain King's inshore route is the better for them, as wood may be obtained along the east coast; nor do I see why the voyage from Sydney to Singapore need take more than five weeks, as the SE. winds will be carried up to 14° or 15° S. before the West wind sets in.

*The Bligh island passage route.**—After doubling cape Rodney and the SE. part of New Guinea, vessels should reach 9° 10′ N. and make the westing on that parallel, passing north of the Eastern Fields and Portlock reefs. Thence run 4 or 5 miles south of Bramble key, a sand bank about 9 or 12 feet above low water, and visible 7 or 8 miles from the masthead.

During the night it is well to avoid the southern part, between Bramble key and the ledge of reefs to northward of Darnley island, and anchor north of Bramble key in about 22 fathoms of water. However, a ship can lie-to or stand off and on to the northward of the key, being careful not to get inside of 7 fathoms on the coast of New Guinea.

Near Bramble key the flood comes from NE. or East at a speed of, sometimes, 2 knots; the ebb comes from the opposite direction, and is swifter. It is generally safe to count on a knot of westerly current, unless the strait is approached after a squall, when a greater allowance should be made.

Water may be obtained on Darnley island, but the men should never go on shore in these localities without being well armed.

The Raine island passage.—Captain Charles Harrold gives the following full and complete instructions on the Raine island route:

"Having made the passage from Australia to India through Torres strait upward of a dozen times, and hence having had considerable experience of this route, the following remarks may prove acceptable to those commanders who have not been through before:

"A ship leaving Sydney early in the season, from the beginning of April to the middle of May, should at once get an offing; later in the season it is better to keep the land aboard (and with strong westerly winds) as far as Solitary isle or mount Warning; but should the wind veer to the southward, with a rising glass, shape a course at once to pass 40 or 50 miles to the eastward of Cato bank; steering on a northerly course, keeping at least a degree to the eastward of Kenn reef, after passing which a NW. course may be pursued, taking care to give the cays and Lihou reefs a good berth of 50 or 60 miles. After leaving these dangers there is nothing on the track to the Great Barrier; the Osprey reef and some others to the southeastward are quite out of the way, and a ship has no occasion to go near them.

"In approaching the Great Barrier considerable care is necessary, if no observations for latitude have been taken; and an allowance must be made for the northwesterly set, so as not to get to the northward of Raine island beacon. The plan I always adopted was not to run down on the Barrier and work to windward all night; but should the ship be upward of 200 miles off at noon, and not be able to enter the next day, I would reduce sail at once and steer slowly on a course from 2 to 5 knots, according to distance, so as to reach within 30 miles of the Great Detached reef by the second morning at daylight. Should no observations for latitude have been taken (or whether or no) when breakers are sighted from the masthead, ahead of the ship or a little on the port bow, as you draw toward the reefs, or should you see them on the starboard bow as far as can be seen from the masthead, you may be sure you are to the north ward, and may haul up immediately on the port tack; and if the wind is far enough to the eastward to lay along the reef, you will soon see clear water, and sight the beacon from the masthead; or should it be the Great Detached reef that you sight, clear water will be seen on the starboard bow, and by edging to the WNW. you will shortly see the beacon. I have always found this a good guide for Raine island, for if you get too far down toward the reefs before you find out your mistake, you will have great difficulty in working to windward. Should you be to the southward, which will rarely happen when steering for the Great Detached reef, you will be sure to see Yule reef, and could then take Stead passage, which, however, is not very easy to make.

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* Directions for the beginning of this voyage, from Sydney to the end of the reefs, will be found under the head of "3d Raine island passage route."

"After making the beacon and steering down with it a little on the starboard bow the edge of the Great Detached reef will be distinctly seen, also the reefs off Raine island; when the beacon bears North haul up SW. by W. After a few miles a very small sand bank will be visible from the masthead, on the starboard bow, and if you see it distinctly from the deck of a small vessel you are falling to leeward, and should haul up more to the southward. This is one place, I think, should have a mast with a sort of basket-top placed on it as a beacon; it would be a good guide for ships entering late in the afternoon; for, after passing this, you are near the edge of soundings, and with night coming on, after getting on soundings, you should haul well to the southward and bring up at dark, taking care to give at least 60 or 70 fathoms of cable, as the holding ground is here very bad (hard coral). From this anchorage keep well to windward of the course until you sight either Ashmore banks or the Middle banks. Ashmore banks show much higher out of the water and whiter than the Middle banks, which latter are at high water nearly covered. This also would be an excellent place for a mast beacon. If there is sufficient daylight to reach Ashmore banks, or under the lee of Cockburn reef, a better anchorage may be obtained; or if it should be blowing a gale, with squally weather, good anchorage in smooth water may be obtained under the lee of Sir Charles Hardy islands. In going in, keep close to the weather island, and anchor well to windward in a small, sandy bay; by so doing you will be in a better position for weighing in the morning. In anchoring here one voyage the chain fouled on the windlass, and before the other anchor was let go we were in mid-channel. Next morning the tide would not let the ship cant any other way than head to the northward. The topsails were single reefed and yards hoisted to the masthead before commencing heaving. The ship broke ground with the 15-fathom shackle in the hawse, and before we got the anchor off the ground and sail made we were close down on the leeward island, and only cleared it by scarcely a stone's throw. In coming out from here you will have to keep NE. by N. for a few miles. and might have to tack should the wind be to the eastward; but you can see the Middle and Ashmore banks quite plainly. If there is sufficient daylight to reach Cockburn reef, it will be found a still better anchorage than under Ashmore bank. It is quite smooth, especially at low water, although you require a good scope of cable, as the ground appears to be hard coral. In weighing from here you will soon see the edge of the reef that stretches to the NW., and you may run down toward it until you can see it distinctly from the deck; then edge away along the reef, and as you draw toward the end you will see two sand banks; the nearest one is small, and probably may be covered at high water, although I have never seen it quite covered, but you will be sure to see it from the foreyard before you get too close, and very likely before they see it from the masthead. If bound to Bird island, haul close round the small sand bank, leaving the large bank on the starboard hand. This bank is high out of water, with an extensive reef running off the weather side of it, which is also seen distinctly from the deck. This track I prefer to going close round the end of Cockburn reef and having to haul to the southward. If bound on to Cairncross island, leave the large bank also on the port hand, and, steering for the Hannibal island, reefs V and W will be seen, with a small sand bank on reef V, also the Boydong cays.

"After passing V and W reefs the great danger of Torres strait is past and all sail may be carried down to cape York; or anchor at Cairncross, and the next day with fresh breeze you will get out in good time.

"If the wind should be light and a ship not able to reach cape York or mount Adolphus before dark anchor close under the lee of a small sand bank at the end of reef X, which is far preferable to Turtle island; but should the night be fine and moonlight, having reached thus far, a ship could run on and, passing Albany isles, anchor round cape York. If rounding this cape in daylight, anchor abreast of two rocky islets a short distance past the cape in 7 or 8 fathoms water, cape York bearing E. ½ N., Peaked hill SSW.; this is a very good anchorage and you will be in a position to choose either Prince of Wales passage or Endeavor strait. If intending to pass through the Prince of Wales channel, which is buoyed and beaconed, with no danger excepting a strong tide, should the wind be light and contrary, after passing the Albany isles steer to pass Ince point, ½ mile off, taking care to avoid rock A; the northwest reef can be seen from the masthead a long while before you reach the point; at any rate, should it be hazy or squally, by passing Ince point close, the northwest reef will be avoided and Hammond rock will be seen; steer to pass close-to, and before reaching it the Ipili reef will be distinctly visible, the rocks on it sticking up above water. Borrow toward Ipili reef to clear Sunk reef; after passing this danger, the last in the straits, Booby island will be seen. Should you intend to anchor leave the island on your port hand as the reef extends to some distance off the other side. The landing is very bad at low water, but you can pull close to the entrance of the cave at high water. I was once detained from noon until 9 p. m. to land a few casks of water sent by the Government.

"If intending to go by Endeavor strait, which is quite safe after passing Possession isle, you are soon out of the strong tide. I have always passed close to a high rugged island (Entrance island) west of Great Woody island as far preferable, and it leads you clear of McKenzie and Gibson rocks. My last voyage I towed through with the boat ahead, and shortly after a breeze came from the SW. and squally, and we worked down within 3 or 4 miles of Red Wallis isle and brought up when the tide turned. Should the weather be clear and fine as you draw abreast of Red Wallis island a good mark for mid-channel is cape Cornwall on with Peaked hill, from which steer to pass out to the south of Rothsay banks.

"In conclusion I again repeat that, in running for the Great Detached reef, 25 or 30 miles is quite close enough to come to it until daylight; for if a ship gets to either Ashmore bank or Cockburn reef the first night, or even only just on sounding, she will reach Cairncross island the next day and out clear the day following, and she would not do any better by getting in earlier. She might reach Bird island the first night, but she would have to anchor under cape York the next, excepting she were a very fast ship, with wind and tide in her favor, and then she might get through; but it rarely happens that a ship passes through with once anchoring, and it is certainly not worth the risk of running down close on the barrier for the sake of twelve hours. I have often gone through it in forty-eight hours, viz., twenty-six at anchor and twenty-two under way. I am satisfied that nearly all the wrecks have taken place through the anxiety of masters to get in early, and to running down too close on the Barrier. The wrecks inside I attribute to going off the tracks laid down, and running in squally and thick weather. Great improvement might be made by placing a few mast beacons (with basket tops to distinguish them by) and buoys at various places and the passage by Raine island rendered much easier for a stranger going through for the first time."

Route from Torres strait to Singapore.—After leaving Booby island or clearing Endeavor strait vessels make to the westward with a fair wind. A good lookout should be kept for the banks beyond Booby island, as they are not all accurately located, especially Proudfoot, Lucius, and Aurora shoals. Wessel island should always be passed about 20 miles to the northward; thence the track lies between Croker island and Money reef. Afterward the course should be shaped so as to run about 20 miles south of Damo or Dana (to southward of Rotti); this will take the ship close to Echo bank and well clear of Hibernia and Ashmore shoals, all of them being passed to northward. Thence leave Hockie island (south of Savu) far to the northward and give a wide berth to the south coast of Sandalwood.

Either Lombok or Allas strait can be taken, and the reef south of Baars islands passed several miles to SW.; thence the route lies through Sapudi strait, between the island of the same name and Giliang. Vessels sometimes head straight for Urk island after leaving Allas or Lombok strait. The passage between Urk and Kangeang is better than the one to westward of the former island.

The passage across the Java sea to Carimata strait is quite easy. After leaving Sapudi strait or Kangeang passage it is safest to pass south of Bawean, a bright lookout being kept for Hastings rock; thence the route runs 10 or 12 miles north of the Crimon Java islands. The departure may be taken from Parang island—the most northwesterly of the group—for Carimata, and that island will soon after be raised. Run east of Discovery, Lavender, and Cirencester banks; and when Carimata peak is sighted N. by W. ¾ W., head for it, until able to take the position of the vessel by cross bearings on Carimata and Seruta islands. Thence bear to the westward, and pass between Seruta island and Ontario banks. Auxiliary steamers can head for Rhio strait from this point; but sailing vessels should make for Singapore strait, passing east of Bintang, and looking out for Pratt reef, Frederick rock, Geldria bank, and all the dangers off Panjang. This island should be doubled to NE., when the course should be for Horsburgh light. The south channel, 3 or 4 miles to southward of the light, can be used.

During the NW. monsoon it is hardly advisable to take the route through Torres strait from September to May. For though it is possible to run through Bligh passage at this season, the danger of losing your vessel among the reefs is great, and much time will be lost while at anchor during the squally weather frequent in that locality. Vessels with steam power can take this route if they have enough coal on hand to reach Kupang (Timor), as it is doubtful if they can fill their bunkers on the NE. coast of Australia.

The best route for sailing vessels leaving Sydney during the NW. monsoon consists in following at first the route for Bligh passage. Keep well to west of Bampton reef, pass east of Mellish shoal, and round San Christoval island (the most eastern of the Solomon group) to the eastward. Some vessels prefer passing west of Mellish shoal, coasting the southern shores of the Solomon group, and running north of New Ireland, where they sight St. John and the Green islands. Whether passing east or west of the Solomons, always keep clear of the New Guinea coast, particularly in November, December, and January. A ship should reach the neighborhood of 6° N. as soon as possible; here the prevalent NE. wind will probably enable her to head for the Pelew islands. After passing these islands to the southward enter the Celebes sea, by the Serangani islands; the Sulu sea, by Basilan strait; and the China sea, by Balabac strait.

For further information the reader should refer to the examples given in § 140. Information concerning the first part of the passage will also be found in § 177, and the voyage should end by following the return route from Singapore to Palawan passage (§ 155).

§ 176. **Southerly route from Australia to India, Batavia, and Singapore.**—We do not advise this route, and the reader may perceive, by referring to the preceding section, that Torres strait may always be taken from May to August, even if the port of departure be Melbourne.

From September to May the route passing north of New Guinea, though longer, is, we think, preferable to that by the south of Australia, especially for poorly-fitted-out vessels or slow sailers. Still, this route can be taken, from October to March, by vessels leaving port Adelaide, Melbourne, or even Sydney. Fine passages are often made at this season, but the voyage is generally boisterous, and the weather bad. From cape Otway to cape Leeuwin both wind and current are frequently contrary; nor is it rare to strike a NW. or SW. gale and heavy sea in this part of the voyage. Vessels leaving Sydney can run through Bass strait, especially in January, February, and March. Of course, if vessels have steam to rely on in case of necessity, and are well equipped in other respects, they can take the southerly route.

We, however, would never advise this route for vessels leaving Sydney, or even Melbourne, during the southern winter; and captains bound to port Adelaide should endeavor to make their arrangements so as not to leave that port for Batavia or Singapore during the winter months.

We will now quote the instructions of the British Admiralty and of Horsburgh:

British Admiralty route to the westward, south of Australia.—"Ships bound from Sydney to Europe or Hindustan may, from the 1st September to the 1st April, proceed by the southern route through Bass strait, or round Tasmania, easterly winds being found to prevail along the south coast of Australia at that season, particularly in January, February, and March, when ships have made good passages to the westward, by keeping to the northward of 40° S., and have passed round cape Leeuwin into the SE. trade wind, which is then found to extend farther south than during the winter months. In adopting this route advantage must be taken of every favorable change of the wind, in order to make westing; and it is advisable not to approach too near the land, on account of the SW. gales which are often experienced, even in the summer, and the contrary currents, which run strongest in with the land. The prevalence of strong westerly gales renders the southerly route very difficult; indeed, generally impracticable for sailing vessels in the winter, although the passage has been performed at that season by ships in good condition that sailed well; but the northern route through Torres strait is perferred in the winter months."

Horsburgh's instructions.—"Ships bound from Sydney to Europe, or Hindustan, may adopt the southern passage, through Bass strait, or round Tasmania, if they depart between the beginning of September and the end of March. In the month of January, February, and March SE. winds frequently prevail about Tasmania, and near the coast of Australia, enabling ships to make considerable progress to the westward; they ought, however, to preserve a considerable distance from the south coast, in order to benefit by every change of wind in their favor, and to avoid being driven too near the land by southerly or SW. gales, which are likely to happen at times. The strong westerly gales which prevail here in winter render the southern passage difficult; yet it has sometimes been performed, even in that season, by ships which were in good condition and sailed well."

§ 177. **Route from Australia to Cochin China, China, and Japan.**—*During the SE. and SW. monsoons.*—Vessels bound to Saigon, and even those bound to Hongkong, from May to August, should follow the route indicated in § 175 and pass through Torres strait. They should enter the China sea by Carimata strait and finish the voyage as stated in §§ 154 and 155.

Vessels bound to Hongkong can also take the route north of New Guinea. After passing the Serangani islands and Basilan strait, they should enter the China sea south of Mindoro. If it be decided to follow this route, the course from Sydney should be ENE., so as to pass to southward and eastward of Ball pyramid. The northing should be made between 159° and 161° E. A good watch should be here kept for the reefs marked on the charts, as well as for those which are supposed to exist between 23° 30′ and 18° S. After reaching 14° or 13° S., the course should be about NW. for St. Georges channel; this will also carry the ship clear of Pocklington bank and Laughlan islands, as well as the west coast of Bougainville. Vessels should be careful not to let the current set them to the westward, as they may then be unable to make St. George sound. If this does happen, Dampier strait, between New Britain and Rook island, can be taken. This strait is little frequented, and can only be crossed by watching the reefs carefully from the masthead.

After clearing St. Georges channel the course should be West or WNW. to pass to northward and eastward of the Admiralty isles, and thence between the Hermit and Anchorite islands, or a little to northward of the latter. Thence the route keeps south of the line as far as the Providence islands, which should be doubled to the northward; thence passes east of the Asia islands, and half way between Morti island to the west and Lord North island to the east. During this last part of the route it is probable that the currents will first set to NE., then to East, and finally to West.

After leaving Lord North island the course is for Meangis and Serangani islands and Basilan strait. A bright look out should be kept for Iphigenia reef. The passage ends as described in § 151, in the description of the route to China (during March and April) for vessels which have taken Makassar strait, and afterwards passed through Basilan strait and along the west coast of the Philippines.

Vessels bound to Shanghai and Yokohama can follow the same route until they are north of New Guinea. They should cross the equator near 142° E., and pass east of the Pelew islands, when they will begin to find the variable NE., NW., and SW. winds, generally known as the SW. monsoon. If bound to Shanghai, they should run south of the Luchu islands, and thence easily finish the voyage with the frequent SW. winds. Typhoons are frequent in this locality from June to November (§ 20). If bound to Yokohama they should, after leaving the Pelews, head for the passage between the Borodino and Luchu islands; thence both the winds and Kuro Siwo current will be favorable. (See § 37.)

During the NW. and NE. monsoons.—During this season (from September to March) you will have a choice between two routes called the "Easterly route." The first passes west of New Caledonia and the Santa Cruz islands, and east of the Solomon group. This is the shorter, but has the inconvenience of running through localities where reefs are numerous and not all located. The second route runs east of New Caledonia between the Fijis and the New Hebrides. It is longer, but safer, and more clear of dangers. It also passes through a zone of steadier winds, and is probably the better for vessels leaving Melbourne or coming from Europe by the south of Australia. Passages by this route are quite as rapid as by the other.

Route passing west of New Caledonia.—The course out of Sydney should be ENE. and to the southward and eastward of Ball Pyramid.

The northing should be made between 159° and 161° E., between which meridians a careful look out should be kept for reefs. Keep well clear of the reefs lying to NW. of New Caledonia, especially as the wind is liable to be from SSW. to NNW. in that locality. Afterward head NNE. as far as 164° E., when follow this meridian to the north and thus pass between San Christoval and Santa Cruz islands.

Vessels to eastward of the Solomon islands, and the islands and reefs situated to the north, at the beginning of the NE. monsoon, should steer N. by W. or NNW. if possible, and cross the Carolines between 155° and 149° E. A bright look out should here be kept for new reefs, as well as for those on the charts, as the positions of many of them are not accurately determined.

Once north of the Carolines, the course should be laid for the south point of Guam island (the most southern of the Marianas), which can be passed on either side. A vessel north of the island can take either the channel south of Tinian or that north of Saipan. Enter the China sea by the Bashees and finish the voyage as indicated in § 151, under the description of "The route from Hongkong to Pitt passage."

If the Solomon islands are doubled after January, when the SE monsoon is no longer settled, the course should be NW., so as to run between Yap island and the Ngoli (or Matelotas) islands. Vessels can also go between the Ngoli and Pelew groups; thence round the NE. extremity of Luzon at a convenient distance and take one of the passages between Luzon and Formosa. Finish the voyage as stated in § 151, "Route by Pitt passage."

Route passing east of New Caledonia.—This route passes east of Norfolk island and close to Mathew rock; the latter is visible for 25 miles. After running to eastward of Mathew rock the course should be N. by E. or North, a good look out being kept and due allowance made for the westerly current. Keep between the 171st and 172d meridians without attempting to sight Erronan island, and thus double the New Hebrides. Vessels can pass between Erronan and Tamra if drifted to westward. It is, however, generally best to pass well east of all the islands; if the chronometers be faulty, Fataka (or Mitre) can be sighted at a distance of 22 miles. Thence the course is North or NNW. for the line between 160° and 168° E. If the westerly current, which is strong in this locality, will allow, the attempt should be made to run through the Caroline group between 162° 50′ and 162° 20′. But if the equator be reached between 160° and 162° E., it is best to cross the Carolines between the meridians of 156° and 155°, as there are fewer reefs and islands in that locality.

Once north of the Carolines, the course should be about West in order to pass south of Guam, or through one of the passages situated in the northern part of the Mariana group, the one south of Tinian, or that north of Saipan, for instance. Thence the vessel should be headed for one of the channels between Luzon and Formosa. For information concerning the end of the voyage, see § 151, "Route by Pitt passage."

Vessels bound to Shanghai or Yokohama can follow either of the above-mentioned routes; the latter is, however, the preferable. Passing east of the Solomon islands they should cross the equator in the neighborhood of 166° or 168° E.; and, after striking the NE. trades, run on either side of Ualan and Providence islands, and thence north of the Marianas.

Vessels bound to Yokohama should keep west of the Volcano islands, and reach 30° N. to westward of their port. Between 28° and 31° N. the current will be found favorable, and the wind variable or westerly. Ships bound to Shanghai should run north of the Marianas, or between Grigan and Assumption; thence north of the Borodino and Luchu islands, whence the voyage will be easy.

§ 178. **Route from port Adelaide, or Melbourne, to Sydney.**— We will only give a résumé of this route, as information concerning it will be found in several other sections. After leaving Melbourne, or port Adelaide, the course is through Bass strait, unless there are indications of an East wind. January, February, and March are the months when a wind from this direction is to be feared. If Bass strait is taken, Horsburgh's instructions, given in § 105, should be followed. A NE. by E. course from the Kent group clears cape Howe by about 60 miles; it is, however, advisable to head much farther to the eastward if the wind is strong from the South. By disregarding this precaution, as Horsburgh and the British Admiralty both remark, a vessel may bring up on a lee shore in the center of the bight, which is 150 miles long, and lies between Wilson promontory and cape Howe, on the Australian coast. There is a light on Gabo island, south of cape Howe. Cape Howe is a low, sandy, and rocky point, making out from the foot of the mountains.

Vessels passing west of Tasmania should keep well clear of the coast until they are to eastward of the island, when they should run up along the land for cape Howe, as stated in § 105.

The latitude is the surest guide in approaching the eastern coast of Australia. The soundings extend for 12 or 15 miles from the land.

CHAPTER XI.

ROUTES FROM CHINA AND ASIA TO AUSTRALIA.

§ 179. **Routes from Singapore to Australia.**—*The Southerly route.*—This route may be taken at all seasons.

The most frequented route to the SE. coast of Australia is that which passes south of that continent. The mean passage to Melbourne and Sydney is from nine to ten weeks. Voyages under canvas have been as quick as seven weeks to Sydney, and a few days shorter to Melbourne. The voyage to port Curtis and New Caledonia is ten or fifteen days longer. Only well equipped and staunch vessels should attempt to make this route..

From Singapore to Banka and Billiton the wind is North and NW., between November and March; there is, however, a slight chance of striking a West or WSW. wind. If the wind be fresh and steady, run for Bali strait; otherwise, time may be lost in attempting to beat against the SW. wind in the strait of Sunda. Latterly, Bali strait is used by the Dutch vessels going from Batavia to Europe, as they prefer to run to the eastward along the southern coast of the island rather than to beat through the strait of Sunda. Bali strait is clean, and does not need a pilot; it is easy of exit from November to March, even when the wind is from SW., as it is open to SE. Allas strait is perhaps better (§ 115). Good water and provisions can be obtained at Banjuwangi. Vessels usually find calms and light, baffling airs, or southerly squalls, in the Indian ocean, between the monsoon region and the steady SE. trade belt; sometimes the transition period only lasts a few hours. The zone of SE. trades lies between 10° and 32° S. The trades are occasionally found as far south as the 40th parallel. Ships bound to port Curtis, or New Caledonia, should run south of Tasmania, and thus get clear of the East winds, which, during the summer, are quite frequent in Bass strait. In the high southern latitudes the wind is cold and variable, but a well-clothed crew will not suffer much. After doubling Tasmania the course is straight for New Caledonia. Vessels bound to port Curtis should not go within 300 miles of the east coast of Australia until they reach the parallel of Sandy cape as NE. winds are very frequent near the coast. If they need stores, they can stop at Hobart town.

The southerly route is certainly the quickest from May to September inclusive. The winds will be ahead and from SE. as far as the strait of Sunda; it is, however, easy to clear the strait and enter the Indian ocean, when the SE. trades will be found strong and settled as far as 28° S. Below this parallel are the 'brave West winds' to carry you toward your destination. These winds weather cape Howe and blow from South and SW. along the eastern coast of Australia as far as the tropic, thus giving a fair wind to port Curtis or New Caledonia at this season. The faults of this route are the SE. winds from Singapore to the strait of Sunda, and the cold winter weather in the high southern latitudes; a heavy cross sea is also here frequent, caused by the sudden shifts of wind from NW. to SW.

The reader should refer to § 105, where will be found instructions on the advantages and disadvantages of Bass strait; also to Horsburgh's instructions. We would especially caution the reader concerning the danger of running too close to the west coast of Tasmania (§§ 105 and 108).

We are indebted to the Dutch Observatory for the following table, which contains the crossings, etc., of nine routes, from the strait of Sunda or Lombok strait to cape Otway:

Routes from Java to Australia.

Date of departure from the strait of Sunda and Lombok strait.	CROSSINGS AND DAYS AT SEA TO REACH THEM.											
	Lat. 10° S.		Lat. 15° S.		Lat. 20° S.		Lat. 25° S.		Lat. 30° S.		Lat. 35° S.	
	Long. E.	Days.	Long. E.	Days.	Long. E.	Days.	Long. E.	Days.	Long. E.	Days.	Long. E.	Days.
	°		°		°		°		°		°	
March 4	103.2	2.5	98.8	4.7	95.0	6.8	93.2	8.7	92.0	11.0	95.8	14.0
May 12	103.5	3.2	99.8	5.5	95.0	6.5	92.5	9.2	96.2	15.5	114.0	28.0
May 17	103.5	3.2	99.8	5.5	95.0	6.5	103.5	14.2	108.0	17.2	112.5	24.0
May 18	103.5	2.5	101.7	4.5	100.5	9.2	98.0	12.0	100.5	15.0	101.2	18.5
July 22	115.0	1.0	110.5	2.8	107.5	5.8	101.5	9.8	99.8	11.8	99.8	16.5
August 18	103.2	1.8	99.8	3.8	98.8	6.0	99.8	10.0	96.0	12.8	96.8	17.8
September 9	114.5	0.8	108.0	5.0	104.8	8.2	102.5	14.0	101.5	20.8	105.5	24.8
October 26	101.8	2.8	98.8	5.2	97.5	8.0	97.2	11.0	104.5	21.0	111.2	24.0
November 5	104.8	5.8	104.0	11.2	99.2	14.8	96.8	17.5	98.0	20.0	109.5	26.5

Date of departure from the strait of Sunda and Lombok strait.	Long. 115° E.		Long. 120° E.		Long. 125° E.		Long. 130° E.		Long. 135° E.		Days at sea to cape Otway.
	Lat. S.	Days.	Lat. S.	Days.	Lat. S.	Days.	Lat. S.	Days.	Lat. S.	Days.	
	°		°		°		°		°		
March 4	36.8	20.5	37.5	22.5	39.0	23.8	38.7	25.2	39.0	26.2	32.0
May 12	35.2	25.2	36.5	24.0	28.2	26.2	38.5	27.2	38.5	29.0	33.5
May 17	36.2	25.0	37.2	26.2	39.5	28.8	41.0	33.0	40.2	35.0	39.0
May 18	41.8	29.0	39.8	30.0	40.2	31.8	39.8	33.2	39.8	34.5	39.0
July 22	40.2	22.0	40.8	24.0	40.5	25.2	39.8	26.8	39.2	29.0	31.8
August 18	38.5	25.2	39.5	26.8	40.0	28.0	40.0	29.2	40.0	30.5	33.5
September 9	37.5	28.2	38.5	31.2	39.0	33.2	39.8	34.8	40.8	38.0	42.0
October 26	37.0	25.2	38.2	28.0	39.5	29.5	39.5	31.0	40.5	34.5	38.5
November 5	37.0	28.5	38.0	30.5	39.0	31.8	39.2	33.0	39.2	34.2	36.5

The Northerly route.—This route should only be undertaken from May to September. Captain Hunter remarks that the track from Singapore to Australia, by way of the north Pacific, has never been tried, nor is it practicable for vessels bound to ports south of Moreton bay on account of the frequency of the southerly winds between the east coast of Australia and New Zealand. Though the delay caused by these winds will be great, the voyage may be accomplished by passenger vessels wishing to avoid the cold weather of high southern latitudes.

Vessels leaving Singapore, Saigon, or Hongkong during the season of the SW. monsoon, can pass through Formosa channel, if about to follow the northerly route; or, what is perhaps better, they can enter the Pacific by the Bashee Island channel, south of Formosa, as they will then have the Japan current in their favor. According to Horsburgh it is well to run for 167° or 172° E. before bearing south of 30° N.; a good weatherly sailer, however, may enter the trades even ten degrees more to the westward. It would also seem that the easting might be made between 25° and 30° N., with the SW. monsoon of the China sea. Captain Hunter states that both water and stores may be obtained at Peel island, one of the Bonin group.

The harbor on the western coast of the island is much frequented by whalers; vegetables and turtles being there found. Vessels can also put in at the Kingsmill islands or Pleasant island; they are both abundantly provided with fresh provisions.

Further information concerning this route will be found in § 181.

§ 180. **The easterly routes from Singapore or Batavia to Australia, New Caledonia, and New Zealand.**—*When starting from the 15th November to the 15th February.*—Captain Hunter has given interesting and detailed instructions concerning these easterly routes, between Singapore and Australia (Ann. Hydr., vol. 16). We give his statements below in as condensed a form as possible:

Before deciding on a route the reader should, however, first refer to the preceding sections, where will be found instructions on the southerly route.

Though the easterly route is the most direct from Singapore to Sydney, port Curtis, and New Caledonia, the wind is not always favorable during the whole voyage. Still vessels leaving Singapore from the middle of November to the middle of February may count on a fair wind.

There are two easterly routes: 1st, that passing north of New Guinea, which is better fitted for sailing vessels of over 150 tons; 2d, the one through Torres strait, which is better for all vessels with steam power and sailers of less than 150 tons, especially if they are packets and have to stop for provisions or water.

The route for sailing vessels to the northward of New Guinea.—*The first part of this route was given in § 115. From Singapore the course is for Gillolo or Pitt strait. Provisions may be obtained at Bonthein (southern extremity of Celebes), or at Gebi (Gillolo passage). The anchorage at Bonthein is large, and safe during the westerly monsoon. Excellent water, wood, vegetables, etc., may be here obtained at moderate prices. At Gebi the anchorage is equally good; though fresh water is abundant, the provisions are inferior. Vessels bound through Dampier or Pitt strait lengthen their passage somewhat by stopping at Gebi.

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*The author again repeats that the route south of Australia is the best for sailing vessels. The reader is also referred to the appendix at the end of § 181.

This passage is used by whalers; if set to leeward by the easterly winds, they are in the habit of running down toward the line, in which locality westerly winds are common from November to March.

Dampier ran through the strait which bears his name in 1699, and, coasting the northern shore of New Guinea, rounded New Britain. He found a westerly monsoon quite strong, sometimes even amounting to a gale.

Captain Hunter quotes from the logs of the *Meandre*, Captain Keppel; the *Rattlesnake;* and a vessel under command of Forrest Thomas, to prove the possibility of making this passage to the eastward at any season of the year. He then gives his own experience, as follows: In October, 1855, he was off the Asia islands (situated north of Waigiu island), and aiming to make easting with a light, variable wind and strong westerly current against him; headed North, and on the 19th was in lat. 2° 06′ N., long. 134° 11′ E. He here lost the contrary currents, and steered East, keeping between 2° 15′ and 2° 34′ N. On the 27th the ship was in long. 146° 59′ E. Steering SE., St. Matthias island was sighted. His orders being to cruise in this locality he ran into St. Georges channel and with a favorable current stood for the Solomon group. After cruising among the islands until the 19th December, he carried a westerly wind as far as 169° 36′ E. After passing south of Banks island on the 26th December, he was becalmed for two or three days, then with variable ESE. by-winds he made to the southward and anchored in the bay of Islands on the 15th January. Here is an example of a passage being made by an average vessel, unprovided with studding sails, in the most unfavorable season, and over a route generally considered impracticable. It is, therefore, possible to make this easterly voyage by keeping between the trades and the monsoons, and north of the Equatorial current.

On another occasion, being at 1° S. and 149° 20′ E., on the 23d June, and after having been drifted near New Hanover and St. Matthias islands by a westerly current, running at a rate of from 2½ to 3 knots per hour, Captain Hunter stood North and found a West wind near the equator. He then made to the eastward and reached 155° E. at 0° 45′ S. on the 27th. He sighted Bourka point (Bougainville) soon afterward, and found the westerly current as strong as at

Matthias island. At this season the westerly current does not extend quite to the equator.

In September, 1840, the same captain could not hold his own against the westerly current, near the Admiralty isles, and had to run to 2° N. before losing the westerly set. He then went about to the eastward and made his southing under the eastern coast of the Monteverde islands. Captain Hunter also made the passage from Morti to Bourka (Bougainville) in the month of August. He could, of course, have made the remainder of the voyage, but his orders took him no further than the Solomon group. The line of the westerly current rarely runs north of the parallel of 2° N. Finally, he quotes five vessels which made this easterly passage between January and April; one of them following the equator till east of the Kingsmill group, another keeping near the Solomon islands and New Zealand, and the remaining three running near New Ireland and the adjacent islands. From all these examples, he concludes that a vessel reaching Gillolo passage or Dampier strait, between the 15th December and the 15th March, can make a rapid passage to any port situated in east longitude. Moreover, he thinks the passage practicable at all seasons, provided the ship is kept north of the Equatorial current and between the monsoons.

The following directions for the season of the West monsoon are also given by the same authority:

Northerly and northwesterly winds are common at this time near the cape of Good Hope (New Guinea). To eastward of this point the West wind is generally strong and steady, the current setting to the east, with a speed of from 2 to 2½ knots, between the coast of New Guinea and 1° N. This wind and current will hold while passing the St. David isles, and running north of the Providence islands. Hence there is a choice between several passages. The strait to eastward of Dampier (between Rock island and New Britain) is perhaps the most direct for Sydney, but can hardly be advised until a more complete survey is made of the locality. St. Georges channel can be taken. The best way to make for this passage is to keep along the equator as far as the longitude of the Admiralty isles, and then edge away to the southward and eastward, passing to westward of Matthias island; the reefs and low islands farther to the southward will thus be avoided. Sail may be carried boldly while cruising north of the Admiralty group, as there are no dangers near the line in that locality. The best route, however, especially when bound to any of the islands to the eastward, is that running north of the Solomon.

The following observations were published in the Indian Archipelago Journal, 1851:

Route for steamers and auxiliary steamers by Torres strait.—"The only vessels which have used Torres strait, up to the present time, are those making passage to the westward. The three or four ships which attempted the voyage from west to east experienced great difficulty, from the irregularity of the westerly monsoon (from November to March). One vessel, however, bound from Sydney to port Essington, in April, via the Middle passage, met a NW. wind at 19° S. She made 6 knots per hour for five days, and afterward held the same wind to the Arru islands and Makassar. The fine season in Torres strait, as far as cape York, is from November to March; this is also the season of good weather in the Molucca islands (§ 13). The winds are never strong enough in Torres strait to interfere with a steamer making passage in any direction."

Captain Hunter says: "The Torres strait route is the shortest, the distance from Singapore to port Curtis being about 3,400 miles. It is advised for small vessels, as water may be obtained frequently.

"Vessels bound from Singapore to Torres strait follow the same route as those bound north of New Guinea, until they reach Salayer strait; here the tracks separate; the former, bearing to the SE., keeps along the north coast of Timor. Provisions may be obtained at Maulotte. This roadstead is sheltered from westerly winds, but it is dangerous to run in close when the wind is to the northward of west. Kissa bay is a better anchorage, as small vessels can run well in with the land, the coast being bold and the harbor safe at this season (November to March). Vessels can anchor with equal safety on the south coast of Moa. Water and provisions are obtainable at both anchorages. The best roadstead at Moa is off the four villages, 4 miles from the SW. point of the island.

"Endeavor strait is the best, when coming from the westward. Vessels carry 4½ fathoms, at low water, over the shoalest parts."

As will be seen hereafter, the author prefers the Prince of Wales channel when running for Bligh passage.

The western entrance to Endeavor strait is easily recognized. The depths across the head of the gulf of Carpentaria are about 36 fathoms, while about 120 miles from the entrance the soundings diminish to 30, 19, and 9 fathoms. Captains should be careful to keep south of the parallel of Booby island, to avoid the banks to WNW. In clear weather Prince of Wales island will be sighted at a distance of 30 miles, and before Booby or Wallis island, as the latter can only be seen for 15 miles. There is now a light on Booby island. There are several channels between the sand banks of Endeavor strait. The largest and best lies north of Red Wallis island. The strait can then be safely entered between the points extending from cape Cornwell and Wallis islands, and the two 3-fathom ledges will also thus be cleared. The depths in the passage vary from 4 to 8 fathoms, and, with exception of Heroine and Eagle rocks, the strait is clear of dangers.

MacKenzie's three voyages in the *Heroine*, in 1844–'45–'46, together with a dozen others on record, do not speak very favorably for this route; for after clearing the Barrier the vessels were detained in the open sea by variable winds.

In 1847–'48 a vessel taking the inner route found that the easterly winds, frequent outside the Barrier, rarely blew in with the land; NW. winds were often found, and lasted for several successive days. Generally the monsoon began as a land breeze toward midnight, and, blowing all day, died away calm again in the evening. The inner route is clear of coral reefs, and the weather being fine at this season, the landmarks can generally be made out. Light squalls are, however, common, especially at night.

On dark nights vessels should always anchor until they are 500 miles distant from cape York.

Twelve days is a good passage from cape York to cape Curtis.

To complete the instructions already given in § 116, and which refer to the route via Endeavor strait, we give below Horsburgh's observation:

"Coming from the westward, for Endeavor strait, a vessel standing along the parallel of 10° 50′ S. will first sight at 20 or 25 miles distance the high lands of Prince of Wales islands, extending from NE. to ENE. At 11 or 12 miles distance the northern Wallis island will be raised from the masthead, bearing S. 75° E.; also Booby island, bearing N. ½ E. North Wallis island looks at first like two islands, about a ship's length apart, the southern appearing the larger of the two. South Wallis island is low, flat, and wooded, the largest trees being on its northern extremity. North and South Wallis islands are separated by a dangerous channel 1½ miles wide; the channel south of the Wallis islands, between them and the main land, should not be used, as it is full of shoals."

Steamers follow the inner route from Endeavor strait to Sydney. Auxiliary steamers and sailing vessels should head for the Bligh passage.

Once clear of Entrance island, they should head NE. for 30 miles; this will bring them near Harvey rock; they should then pass between the north Sister and Long island. But instead of Endeavor strait, the shortest and simplest route for auxiliary steamers and sailing vessels is through Prince of Wales channel; this track lies north of Booby island. All experience goes to prove that the Bligh passage is the best; this opinion being substantiated by the following remarks by Captain Blackwood:

"Leaving Surabaya on the 12th January, I took three weeks to reach Endeavor strait. Squalls and light westerly airs caused some delay. A good steamer ought to accomphish the 2,000 miles, to cape York, in ten days.

"From February to the end of March, when the monsoon changed to the SE., ending in a heavy NW. squall the weather was never too bad to interfere seriously with our explorations; and if this one was a fair sample of the usual westerly monsoon, I regard this season as much better than that of the SE. monsoon.

"I think that Captain King's inner route should always be followed by a steamer, as the short delay occasioned by anchoring, during the first five or six nights, will be amply compensated for by the speed, during the day, in the smooth water of this sheltered route. Even with due allowance for the winter storms, common near Sydney, the 2,000 miles distance, from cape York to Sydney, ought to be run in fifteen days.

"I would recommend the Bligh passage for sailing vessels, as the track is clear of coral reefs, and a ship can anchor anywhere."*

From Singapore to New Caledonia and New Zealand.—Instructions relative to the greater part of this route will be found on the preceding pages; we will, however, complete them with a few considerations bearing especially on the latter part of the voyage. Captain Hunter remarks as follows:

"When the route north of New Guinea has been chosen, the easting should be made along the line as far as the 152d meridian, if the wind allow. Once arrived at this longitude, and if bound for New Zealand, the attempt should be made to cross 10° S. near 171° or 172° E.; thence the course should be to the southward, close along the west coast of the Fijis, as the East winds draw to the southward in January, February, and March. Once beyond the reefs of the SE. extremity of New Caledonia, the track is clear. Vessels bound to New Caledonia should also do their best to work well east near the equator, as far as 152° E. It is especially necessary to cross 10° S. well to eastward, as the trades during the southern summer are from East to ESE. as far as 20° S. In this way a ship can pass to windward of the New Hebrides, which, with New Caledonia, seem to form a barrier between the trades of the south Pacific and the variable winds of the Coral sea.

"Vessels taking the Torres Strait route can make the strait by Prince of Wales channel or Bligh passage. Thence the route lies along the south coasts of New Guinea and Louisiade; where the wind will be found from West and NW., and quite steady during the months of December, January, and February, if not later in the year."

Auxiliary steamers can also take the inner route along the east coast of Australia. As an example of this latter route we quote the following:

Passage of the *Guichen* (2d rate), Captain Perrier.—"Left Batavia on the 16th December, 1869. Arrived at Surabaya on the 18th and filled up with coal. Left on the 25th; steamed through Madura and

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* Detailed instructions for the Bligh passage will be found in § 175. One of the advantages there enumerated is the fact that vessels bound to the westward have the sun behind them; of course this is an objection when going in an opposite direction.

Bali straits; banked fires; after passing south of Timor, reached Torres strait, wind very light and from SW. to NW. Ran through Torres strait on the 10th January. Took the inner route, anchoring sometimes at night. Although under the lee of the Great Barrier reef, we had to put into Cleveland bay and wait for a favorable slant to the strong SE. winds. Anchored off Townsville, a place of 500 or 600 inhabitants. Obtained 12 tons of coal and a little wood. Left on the 19th. A violent gale from ESE. on the 21st compelled us to anchor under the lee of Percy islands. Remained there two days; crew cutting wood on the islands. Got under way on the 24th. Anchored in Fitz-Roy river on the 25th, 17 miles from Rockampton; vessel drew too much water to go any farther up the river. Obtained all necessary supplies. Sailed on the 30th, ran out by Curtis channel, and headed for Noumea, where we arrived on the 4th February, after a fifty days' passage from Batavia."

§ 181. **Route from China and Japan to Australia.**—*During the NE. monsoon.*—The NE. monsoon prevails from October to April. Sailing vessels from Saigon generally run south of Australia, touching at pulo Aor (§ 174). They reach Carimata passage as stated in §§ 116 and 115, and follow the southerly route through the Java sea as far as Allas strait. Thence they shape their course for the south of Australia, according to the instructions given in § 179 and the latter part of § 105.

Auxiliary steamers bound from Saigon to Australia, can take the Torres Strait route from the middle of November to the middle of February. The passage from Saigon to pulo Aor should be made as stated in § 174, and thence to Torres strait, as described in § 116. For information concerning the termination of the voyage by the inner route, § 180. It may be useful to remark, that it is not probable there will be any opportunity of coaling between Kupang and Sydney.

Auxiliary steamers can also run from pulo Aor to the Moluccas (§ 115), and then, after passing north of New Guinea, finish the voyage as given for sailing vessels in § 180.

It is hardly advisable for ordinary sized auxiliary steamers to take the route through Torres strait except from the 15th November to the 15th February, as they will at any other season be compelled to use a great deal of coal. They should, unless absolutely impossible, take the route south of Australia at the beginning and end of the monsoon.

Sailing vessels leaving Hongkong should run down the China sea by the outer route described in § 152. From pulo Sapatu they should pass east of the Anambas, and then make for Carimata passage. They can also steer straight from pulo Aor to Carimata passage, but this will make the voyage a little longer. Thence the route runs through the southern part of the Java sea to Allas strait (§ 116). For information concerning the route south of Australia, see § 179 and the end of § 105.

Auxiliary steamers leaving Hongkong should always follow the same track as sailing vessels, and run south of Australia. If need be, however, they can pass north of New Guinea, or through Torres strait, from November to March.

If it be decided to take the route north of New Guinea, it will first be necessary to run through Mindoro and Basilan straits; and, after crossing the Celebes sea to reach Molucca passage as stated in § 153 under the head of "The first easterly route." This route has already been advised in § 153, for the return trip from China against the SW. monsoon; it is also easy to follow it during the NE. monsoon. The Moluccas once reached, either Dampier or Gillolo strait may be used, as advised in the second route described in § 151. The voyage will end as stated in § 180.

There is still another route for an auxiliary steamer, namely, that which, after leaving Basilan strait, runs near the Serangani and Meangis islands. For further information concerning this route, see the first easterly route in § 153. Steam will probably have to be used against the NE. monsoon during a portion of the passage. This route passes far to the eastward of Morti and the Asia islands, and north of New Guinea (§ 180.)

If it be decided to pass through Torres strait, Molucca passage should also be used. Take the channel between Mangola and Obi Major, and then the one between Bouro and Manipa. Thence, with the NW. monsoon, pass south of Banda, Ké, and Arru islands. Cross the Arafura sea according to the instructions given in § 116, and finish the voyage by following the route given in § 180.

The southerly route is probably the best for sailing vessels coming from Shanghai to Australia. They should descend the China sea as stated in §§ 169 and 171, and finish the voyage in the same manner as if they had started from Hongkong.

Auxiliary steamers starting from Shanghai, and not wishing to run south of Australia, can first go to Yokohama (§ 167); and, after coaling there, proceed on their voyage as follows:

From Yokohama.—Both sailing and auxiliary steamers after leaving Yokohama should take the northerly route, and commence the voyage as if bound to California (§§ 120 and 121). The easting should be made north of the 30th parallel, or farther to northward, if necessary, to find the West winds. They should not bear south until the meridian of 165° or even 172° E. is reached. Thence, the voyage is easily accomplished. Pass west of the Ralick islands; and, if possible, east of Ualan island. The NE. trades will be lost between 5° N. and the equator, which should generally be crossed between 162° and 167° E. The variable winds near the equator predominate from the northward and westward at this season, and usually allow vessels to pass, first between St. Christoval and the Santa Cruz islands; then between Mellish and Bampton reefs; and, finally, east of Kenn reef and Cato bank. Thence follow the route from New Caledonia to Australia given in §§ 139 and 181.

During the SW. monsoon.—The SW. monsoon prevails from April to October. Sailing vessels from Saigon run through Mindoro and Basilan strait (§ 159). Thence they have a choice between three passages: first, Makassar strait; second, Molucca passage; third, the passage near the Serangani islands and Gillolo strait. (See the easterly routes from Hongkong to Europe in § 153.) After striking the SE. winds of the Indian ocean the course should be SW., clean full, for the West winds near 30° S. For information concerning the end of the passage, south of Australia (§ 179 and the end of § 105).

Auxiliary steamers starting from Saigon can make a more direct course, and steam to Singapore and the strait of Sunda. Thence the voyage will be the same as that for sailing vessels. Auxiliary steamers can also run through Mindoro and Basilan straits, and pass near the Serangani islands. Thence they can make their easting between 4° N. and the equator. They should run far enough to the eastward to make the Solomon islands with the SE. monsoon, and finish the voyage as described in § 180 (for the season from November to March). Though several authorities state that easting can be made under canvas near the equator at all seasons, we can hardly advise this route for auxiliary steamers. (See appendix to this section.)

Sailing and auxiliary steamers leaving Hongkong should, according to the time of starting, follow one of the two easterly routes described in § 153. After crossing the SE. trades of the Indian ocean they will strike the West winds, and finish the voyage as described in § 179 and the end of § 105. The northerly route can also be followed during the SW. monsoon; in which case the course is the same as if bound for Japan (§ 161); and thence, as if the point of departure were Yokohama.

Auxiliary steamers leaving Hongkong can take the same route as that indicated for those leaving Saigon, and run north of New Guinea; this, however, is a route we should not advise.

Sailing and auxiliary steamers, starting from Shanghai or Japan, should take the northerly route, beginning the voyage as if bound to California (§§ 120 and 121). The West winds will not usually be found below 35° N. It is not advisable to bear south until beyond 167° E., nor is it well, especially in a sailing vessel, to enter the trades to westward of 172° E. This detour is more marked than that given for the route during the NE. monsoon; the doldrums and counter currents of wind in the western part of the north Pacific are thus avoided. The voyage will end in the same manner as that described for vessels leaving during the NE. monsoon:

Appendix to § 181.—We will complete the general instructions, given in the present section, by quoting the following considerations on the voyage from China to Austria (Ann. Hydr., vol. 31):

"In December, 1866, nine vessels left Fuchu for Sydney; six took the China Sea route, some ran through the strait of Sunda, and others through Allas strait for the Indian ocean. Two others and myself took the easterly route and arrived at Sydney in fifty-two, fifty-four, and fifty-six days, respectively, beating the other vessels by from twelve to twenty-five days; and this was the worst season I ever had for making easting near the line.

"On the 7th December, 1855, I left the Serangani islands with a NE. wind, and, steering to the eastward ran through Saint Georges channel and south of the Solomon isles. After crossing 176° E. at 12° S. I experienced violent north winds until I reached the north cape of New Zealand on the 10th February."

Rosser quotes some passages made by the easterly route from May to September; that is, during the SW. monsoon:

"Several vessels attempting this route made very long passages; one took one hundred and one days from Manila to Sydney, and another one hundred and twenty days from China to the same destination; none of them, I believe, made a passage of less than ninety days.

"All the captains who made this voyage state that, after losing the SW. winds near the Marianas, they had light East winds and calms, with strong westerly currents. From May to October, according to my experience, the weather between 2° N. and 3° S. is rainy and calm all along the northern coast of New Guinea after leaving the cape of Good Hope. During most years the currents between these parallels are westerly after attaining a speed of from 30 to 60 miles per day. Between 2° 30′ and 5° 30′ N. there is generally an easterly current at this season, but a merchant vessel will find it hard work to make to the eastward, north of the trades, if she wishes to reach 170° E. It is doubtful if she can always clear Pleasant island. Ascension island (Ponapi) is also comparatively safe, though it is best not to trust too much to the inhabitants.

"From November to February I think that the best route from China to Australia consists in making to eastward, as far as possible, with the NE. trades, and then crossing to the equator. There is a clear passage between the Pelews and the Matelotas, thence keep along the line to 141° E. There is a low, rocky islet or reef at 1° N. and 141° E. The route passes north of the Anchorite islands, and along the equator as far as 163° E., passing east of Saint Christoval, west of Bampton reefs, and approaching the Australian coast in the neighborhood of Moreton bay. It is best to keep near the coast if bound to Sydney or Melbourne, as NE. and East winds are frequent during the summer."

Passage of the *Esmeralda* (Nautical Magazine).—"'Left Fuchu on the 24th September; passed north of Formosa, and ran to 30° N. and 150° E., in order to cross the line at 162° E.; passed east of the Solomon islands, west of New Caledonia, and arrived at Sydney on the 21st November, after a passage of fifty-eight days.'—(Observations of Captain Polack, master of the *Esmeralda*). After taking the above route, Captain Polack advises ships leaving China, from the end of October to the end of January, to pass north of Formosa, if they can, without losing time (referring evidently to vessels from Fuchu). If unable to double Formosa they can run between that island and the Pescadores; and, after clearing the Bashees, stand to the southward and eastward until able to cross the NE. monsoon with a topmast studding sail set. The line will thus be made between 140° and 145° E. From this point there is a choice between two routes: the first—which appears to be the less desirable of the two—lies close to the equator, and passes between New Ireland and Bougainville; the second, and better one, runs along the north coast of New Guinea, and between that island and New Britain. Once arrived at 10° S. and 157° E. the course should be made to pass some distance east or west of Fairway reef. North winds will generally be found near the NE. coast of Australia. This route, from Fuchu to Sydney, is some 600 miles shorter than the easterly route along 30° N. to 155° E. It is also 2,300 miles shorter than the route south of Australia."

Such is Captain Polack's advice. Nothing proves, however, that he ever followed the route himself. Still, we will give his reasons for preferring the New Guinea route to that passing between New Ireland and Bougainville. He does not think that the SW. monsoon reaches as far to the east as Captain Hunter states. If the West winds reach 160° E. it is only in exceptional cases. An experienced captain from Sydney states that, during a three years' cruise in these localities, he never found that he could count on a West wind. This opinion is also substantiated by a whaler at home in these latitudes. Captain Polack also states that, between the equator and 10° S., he found calms and light northerly breezes, with no indications whatever of a West wind. He is firmly convinced that off New Guinea West winds are fresh and constant from November to February, and he believes that the passage from China to Sydney may be made in from thirty-five to forty-five days, especially if below the line in January.

§ 182. **From Sydney to Melbourne.**—Abundant information has been furnished by Captain Flinders, on this voyage, and especially on the passage through Bass strait from east to west. Following are his remarks:

"The three months (January, February, and March), during which the voyage from Sydney to Melbourne may best be made, correspond to the season when the passage through Torres strait is uncertain, if not impracticable. Nor would it be advisable to enter Bass strait before the middle of December or even the middle of January.

"In coming from Sydney or from any other port situated to the NE., the departure may be taken from cape Howe; thence, the course by compass, should not be to the westward of SSW. until 39° 30′ S. is reached, as there is danger of the wind coming out from SE., and setting the vessel into the long bight between cape Howe and Wilson promontory. After reaching 39° 30′ S. steer about W. by S., leaving the Sisters, Craggy isle, and Wright rock (210 feet high) to port; that is, to the southward. On Deal island, the most westerly of the Kent group, there is a light, which is a good landmark. After passing 3 or 4 miles south of the lighthouse the other islands will be successively raised to the south; pass these at about the same distance. The first island is a small one lying to SW., and south of Judgment reef; next are the Sugarloaf rocks and Curtis island. After leaving the latter island the course for King island is about West, and the distance 126 miles. Here there is a light, but it is best to pass 15 or 18 miles north of the island, if the wind allow.

"If the weather be thick or rainy, and the wind come out strong ahead, that is, from SW., there are many points where a vessel can anchor. The following are the best anchorages:

"1st. West cove, in Erith island. This island is one of the Kent group, and is separated from Deal island by Murray pass.

"2d. Hamilton roads, near the east point of Preservation isle. This small island is situated in the northern part of Banks strait between Barren island and Clarke island. It lies several miles east of a line joining the light on Swan island to that on Goose island.

"3d. On the south coast of Swan island, suitable for small vessels, or under the lee of Waterhouse isle, situated in about 148° E. near the north coast of Tasmania.

"4th. At port Dalrymple, near the mouth of Tamar river (north coast of Tasmania).

"5th. At port Sorrel (12 miles west of port Dalrymple), suitable for small ships.

"6th. Several places among the islands of the Hunter group, off the NW. point of Tasmania.

"7th. At Sea Elephant bay, on the east coast of King island, where wood and water may be obtained. There is also an anchorage, sheltered from SW. winds, off the NE. point of this island.

"8th. At port Western between Grant or Phillip island and the Australian coast, near the meridian of 145° 10′ E. Let go here as soon as you are under the lee. At this anchorage the wind will be fair for getting under way and clearing Bass strait.

"9th. At port Phillip, Melbourne roads.

"As the weather in Bass strait is variable and sudden shifts of wind frequent, it is advisable to take all precautions before coming to anchor in an open roadstead, and even when partially under the lee of the land it is well to be ready to get under way at a moment's notice, in case the wind should suddenly change. There is no other advice especially necessary, as navigation through Bass strait does not require more than the usual care and vigilance always requisite at sea."

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